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ABSTRACT

This report discusses in detail the research and development (R&D) elements of the Reagan Administration's budget for Fiscal Year (FY) 1985. Following an introduction (chapter I), chapter II presents an overview of R&D funding in the President's FY 1985 budget. The chapter begins by describing overall R&D spending in terms of the major catagories of R&D (basic research, applied research, and development) followed by discussions of policy goals that have motivated the overall pattern of R&D funding and of federal R&D funding by budget function, including projections of 1989 funding levels. Chapter III discusses the R&D budgets of the 10 government agencies that are the largest sponsors of R&D. They are the Department of Defense, National Aeronautics and Space Administration, Department of Energy, National Science Foundation, Department of Health and Human Services, Department of Agriculture, Department of the Interior, Environmental Protection Agency, Department of Transportation, and Department of Commerce. Each agency discussion concludes with a brief statement of the major policy issues raised by the agency's R&D budget. (JN)

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Research and Development Funding in the Proposed Fiscal Year 1985 Budget

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Special Study

March 1984

SE044505

CONGRESS OF THE UNITED STATES — CONGRESSIONAL BUDGET OFFICE

RESEARCH AND DEVELOPMENT FUNDING IN THE PROPOSED 1985 BUDGET

Special Study

The Congress of the United States
Congressional Budget Office

March 1984

PREFACE

Federal research and development programs are spread across various government agencies and budget functions. This report, prepared at the request of the Senate Budget Committee and the Senate Commerce, Science, and Transportation Committee, presents these R&D programs in a single R&D budget. In keeping with the mandate of the Congressional Budget Office (CBO) to provide objective and impartial analysis, this report contains no recommendations.

This study was written by Louis L. Schorsch of CBO's Natural Resources and Commerce Division, with the assistance of Theresa Dailey, who contributed to the drafting of several sections. The report was prepared under the direction of David L. Bodde and Everett M. Ehrlich. The author wishes to thank Jeffrey Nitta of CBO's Budget Analysis Division for his assistance with developing budget estimates. Valuable comments were provided by Richard Mudge, Andrew Morton, and John B. Thomasian of CBO's Natural Resources Division; Howard Conley, Kathleen Gramp, and Edward Swoboda of the Budget Analysis Division; Thomas Buchberger of the Human Resources and Community Development Division; and John Hamre of the National Security and International Affairs Division. Patricia H. Johnston edited the manuscript, which was typed and prepared for publication by Kathryn Quattrone.

Rudolph G. Penner
Director

March 1984

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CHAPTER I. INTRODUCTION

This report discusses in detail the research and development (R&D) elements of the Administration's budget for fiscal year 1985. 1/ It is a companion paper to a larger CBO report, Federal Support for R&D and Innovation (March 1984), which provides background information concerning the federal role in the innovation process and policy options to improve federal programs in the innovation and research and development areas. Readers should consult that report in order to place the budget data presented here in a wider policy context.

This study provides information on both overall R&D spending trends in the 1985 budget and the proposed R&D budgets of those agencies that are major sources of R&D funding. The most important funding agencies are the Department of Defense, the National Aeronautics and Space Administration, the Department of Energy, the National Institutes of Health (NIH) and the National Science Foundation (NSF). Of these, only NIH and NSF support R&D as their primary mission. For many other agencies, R&D programs are not a central part of their mission, so that information must be extracted from their line-item budget submissions to construct a consolidated R&D budget.

The R&D trends reflected in the fiscal year 1985 budget are described in three ways:

- Requested R&D expenditures are disaggregated according to whether they fund basic research, applied research, or development.
- These expenditures are separated according to budget function. Data are also presented by budget function for projected R&D funding for 1989.
- The R&D budgets of the major agency sponsors of R&D are discussed in detail.

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1. The Budget of the United States Government, Fiscal Year 1985 (February 1984).

This presentation makes it possible to analyze both general trends in the pattern of requested R&D funding and specific policy issues reflected in the funding priorities of different government agencies. 2/

The data presented in this report are based on agency budget submissions to the Office of Management and Budget (OMB) and to the Congress, and on more detailed agency records provided to CBO. All funding levels are for fiscal years. Data on requested expenditures are presented in nominal or current-dollar terms; real expenditures, in 1982 dollars, are given in parentheses after the nominal amounts. For example, total proposed R&D spending in the 1985 budget amounts to $52.78 billion ($46.09 billion). When rates of growth in funding are discussed, the same convention is followed--that is, nominal rates of growth are presented first, followed by real rates of growth in parentheses. Real funding levels are calculated using the gross national product (GNP) implicit price deflator; CBO projections of the GNP implicit deflator are used for calculating real funding levels for fiscal years 1984-1989. Finally, unless otherwise noted, all budget numbers refer to budget authority.

Chapter II discusses trends in R&D expenditures for basic and applied research and for development and funding by budget function. Chapter III presents an agency-by-agency discussion of R&D proposals of those agencies that provide such funding. This chapter also describes some of the major policy issues associated with each agency's R&D budgets.

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2. Other organizations provide analyses of the federal R&D budget with a somewhat different focus from that adopted in this report. "Special Analysis K," published as part of the Budget of the United States Government, is devoted to R&D. The Science Policy Research Division of the Congressional Research Service produces a regular series of reports on the R&D budget, including proposed Congressional action and related issues. The American Association for the Advancement of Science (AAAS) also compiles an R&D budget, written from the perspective of the scientific community. Finally, the National Science Foundation is the government's principal source of information concerning R&D trends.

CHAPTER II. GENERAL FEATURES OF R&D SPENDING IN THE 1985 BUDGET REQUEST

This chapter presents an overview of R&D funding in the President's fiscal year 1985 budget. In order to place this year's request in a historical context, the analysis also provides information about R&D funding in 1984 and 1980. It should be noted that the data for previous years reflect Congressional action on Administration budget requests. In general, the pattern of current R&D spending reflects the Administration's priorities--although the Congress has slowed the tempo of changes, reducing defense R&D requests and slowing the decline in civilian applied research and development. As will be discussed in Chapter III, the difference between the Administration's proposals and Congressional actions are most evident in the R&D budgets of the Department of Energy and the Department of Commerce.

This chapter begins by describing overall R&D spending in terms of the major categories of R&D: basic research, applied research, and development. These categories are defined in the box on page 5. The chapter then discusses the policy goals that have motivated the overall pattern of R&D funding. Finally, the chapter concludes with a discussion of federal R&D funding by budget function, including projections of 1989 funding levels. Readers should note that budget figures refer to fiscal year budget authority and are discussed first in nominal amounts and rates of growth, with real funding levels (calculated in 1982 dollars using the GNP implicit price deflator) and rates of growth presented in parentheses after the nominal figures.

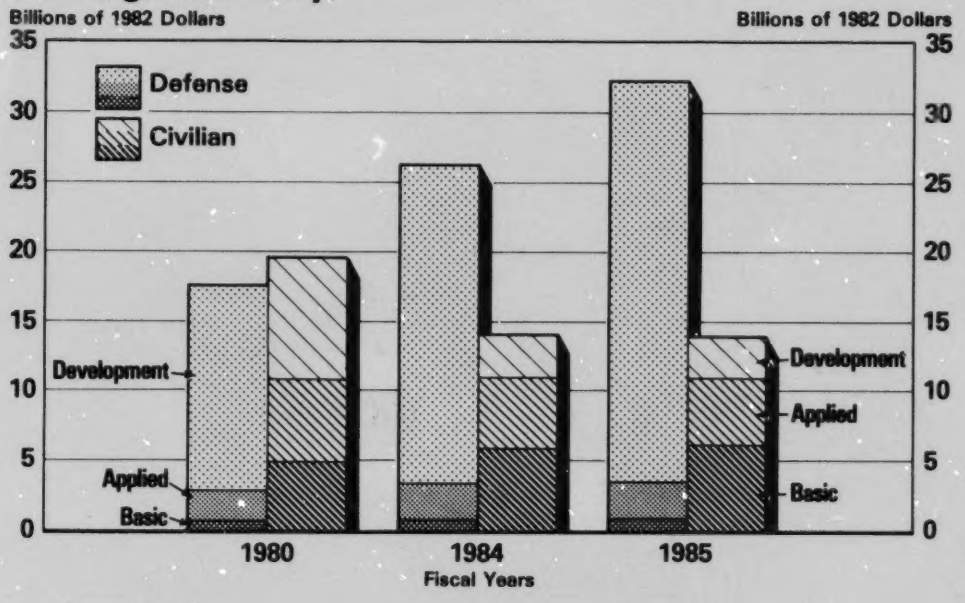
FUNDING TRENDS BY MAJOR R&D CATEGORIES

In general, the President's 1985 budget reflects the same trends that have shaped the Administration's R&D funding requests since 1982. These trends, shown in Table 1 and Figure 1, are:

- Overall growth in R&D funding;
- Increased defense R&D funding and reduced civilian expenditures; and
- Reorientation of civilian R&D from development and applied research to basic research.

Figure 1.

Real Defense and Civilian R&D
(In budget authority)



The 1985 budget continues the Administration's overall commitment to increased R&D funding, both in nominal and in real terms. Nominal R&D funding in the 1985 request amounts to $52.78 billion ($46.09 billion in 1982 dollars)--an increase of 67 (24) percent over the 1980 level. Compared with 1984, the 1985 request calls for an increase of 19 (13) percent in total R&D funding.

The Administration has maintained its strong emphasis on defense R&D, which has risen from 66 percent of total federal R&D funding in 1984 and 47 percent in 1980 to 70 percent in 1985. Defense-related R&D is $37 billion ($32.3 billion) in the 1985 budget, up from $14.9 billion ($17.6 billion) in 1980. This represents an increase of 148 (84) percent. In contrast, funding for nondefense R&D has decreased significantly since the early 1980s, although the greatest proportional reductions occurred in the current Administration's first budget submission. In real terms, nondefense R&D funding in the 1985 request is 1 percent below the 1984 level and 29 percent below the 1980 level.

CATEGORIES OF R&D

Basic research. For the federal government, universities and colleges and other nonprofit institutions, basic research is directed toward increases of knowledge in science with ". . . a fuller knowledge or understanding of the subject under study, rather than a practical application thereof." To take account of an individual industrial company's commercial goals, the definition for industry funding is modified to indicate that basic research projects represent ". . . original investigations for the advancement of scientific knowledge . . . which do not have specific commercial objectives, although they may be in fields of present or potential interest to the reporting company."

Applied research. The NSF states: "Applied research is directed toward practical application of knowledge." Here again, the definition for the industry survey through which NSF collects private-sector data takes account of the characteristics of industrial organizations. It covers ". . . research projects which represent investigations directed to discovery of new scientific knowledge and which have specific commercial objectives with respect to either products or processes."

Development. The NSF's survey's concept of development may be summarized as ". . .the systematic use of the knowledge or understanding gained from research directed toward the production of useful materials, devices, systems or methods, including design and development of prototypes and processes."

SOURCE: National Science Board, Science Indicators 1980 (Washington, D.C.: U.S. Government Printing Office), p. 254.

In the 1985 budget, the Administration continues the reorientation of civilian R&D funding toward basic research, which now represents 44 percent of total civilian R&D funding, up from 42 percent in 1984 and 25 percent in 1980. Nondefense basic research has increased 9 percent in nominal terms (4 percent in real terms) above the 1984 level and 64 percent (25 percent) above the 1980 level.

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TABLE 1. NOMINAL AND REAL PATTERNS OF R&D SPENDING BY TYPE AND CATEGORY, FISCAL YEARS 1980-1985 (In billions of dollars in budget authority and percents)

Type and Category	1980 a/ Current Dollars	1980 a/ 1982 Dollars	1980 a/ Percent Share	1982 a/ Current Dollars	1982 a/ Percent Share	1984 b/ Current Dollars	1984 b/ 1982 Dollars	1984 b/ Percent Share	1985 c/ Current Dollars	1985 c/ 1982 Dollars	1985 c/ Percent Share
All R&D											
Basic	4.7	5.5	14.9	5.4	15.1	7.2	6.6	16.1	7.8	6.8	15.9
Applied	6.9	8.1	21.8	7.4	20.5	8.4	7.7	18.9	8.5	7.4	16.2
Development	20.0	23.5	63.2	23.3	64.5	29.0	26.6	65.0	36.4	31.8	69.0
Total	31.6	37.1	---	36.1	---	44.5	40.9	---	52.8	46.1	---
Defense d/											
Basic	0.6	0.6	3.7	0.7	3.2	0.8	0.8	2.9	0.9	0.8	2.5
Applied	1.9	2.2	12.7	2.4	11.0	2.8	2.6	9.6	3.0	2.6	8.1
Development	12.5	14.7	83.7	18.9	85.8	25.6	23.5	87.5	33.0	28.8	89.3
Total	14.9	17.6	47.3	22.1	61.1	29.3	26.9	65.8	36.9	32.3	70.0
Nondefense											
Basic	4.2	4.9	25.1	4.7	33.7	6.3	5.8	41.6	6.9	6.0	43.6
Applied	5.0	5.9	30.1	5.0	35.3	5.6	5.1	36.6	5.5	4.8	34.9
Development	7.5	8.8	44.9	4.4	31.0	3.3	3.1	21.9	3.4	3.0	21.5
Total	16.6	19.5	52.7	14.1	38.9	15.2	14.0	34.2	15.8	13.8	30.0

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget.

a. Actual.
b. Estimate.
c. Budget request.
d. Comprises R&D spending by Department of Defense and military programs in the Department of Energy.

Since 1980, real R&D funding for civilian development and applied research has declined consistently. In the 1985 budget, nondefense development funding has risen slightly in nominal terms over 1984, representing a real decline of 3 percent. Nominal nondefense applied research is down slightly from 1984, representing a real decline of about 6 percent. Since 1980, real funding for nondefense development and applied research has declined by 66 percent and 18 percent, respectively. Much of the reduction in civilian R&D can be ascribed to sharp decreases in energy R&D programs and to the reclassification of the space shuttle from R&D to operations. Few civilian agencies have been exempt from the pressure to reduce applied research and development funding, however.

PRIORITIES UNDERLYING THE ADMINISTRATION'S R&D BUDGET REQUESTS

The pattern of R&D spending described in the preceding section reflects the effects of two major policy decisions that have shaped the Administration's R&D budget requests. The first and most important is the Administration's major commitment to increased defense spending, including defense-related R&D. It is this increased defense spending that propels the growth in total R&D funding.

The second policy goal affecting R&D has been the Administration's reliance on the private sector to fund many R&D activities that were formerly viewed as the government's responsibility. In the Administration's first full budget (fiscal year 1982), real funding was reduced for all civilian R&D categories (basic research, applied research, and development). Since then, however, the Administration's has refined its priorities in nondefense R&D. Basic research, which can be defined as the pure science characteristic of university research, has received increasingly firm Administration support. The rationale for this support is that such activities are likely to be underfunded by the private sector, although they are crucial for future innovations and therefore confer great public benefits. Within the category of basic research, the Administration has favored the so-called hard sciences (such as physics) on the grounds that they are more likely to contribute eventually to the nation's economic performance or to other goals such as national security.

According to the Administration's budget priorities, federal support is less warranted for nondefense applied research--which can be briefly described as scientific activities directed at solving specific practical problems--and development--which is the resolution of technical problems associated with transforming research into usable products and processes. In the view of the Administration, adequate incentives exist for the private

sector to carry out most development and applied research. This perspective is particularly evident in the major cuts for nondefense development activities, such as energy demonstration projects. Development projects tend to be more expensive than research, whether applied or basic.

The dual priorities of increased support for defense-related R&D and a concentration on basic research in nondefense R&D have generated the following overall pattern in 1985 funding:

- Basic research accounts for about 15 percent of total R&D spending, almost identical to its share in 1980;
- Applied research has fallen from 22 percent in 1980 to 16 percent in 1985; and
- Development has increased its share of total R&D funding from 63 percent in 1980 to 69 percent in the 1985 request.

Despite the curtailment of nondefense development, development funding has grown because it dominates defense-related R&D. Defense-related development includes the construction and testing of weapons prototypes, activities that require substantial expenditures. Development has increased its share of defense-related R&D to 89 percent in the 1985 budget, up from 84 percent in 1980.

The fact that applied research has lost the most ground in the overall R&D budget is therefore the product of two trends: increased defense spending, which generates large increases in development funding, and the reorientation of nondefense R&D toward basic research and away from applied research and development. Issues posed by the real decline in applied research funding are discussed in the companion paper, Federal Support for R&D and Innovation.

R&D SPENDING BY BUDGET FUNCTION

This section breaks down federal R&D spending according to budget function. Many budget functions do not entail major R&D expenditures. Those that support significant amounts of R&D are Defense (050); General Science, Space, and Technology (250); Energy (270); Natural Resources and Environment (300); Agriculture (350); Transportation (400); and Health (550).

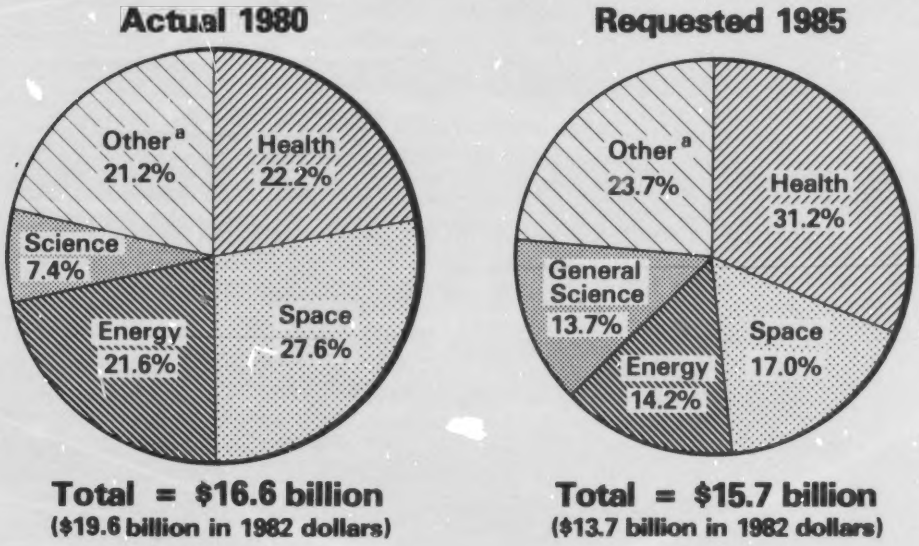
Current Trends: 1980, 1984, and 1985

Table 2 shows funding trends since 1980 in the budget categories listed above. The space and general science components of function 250 have been split, and all R&D funding supported by the budget functions not listed above are aggregated into an "other" category. The programs that make up different R&D budget functions are described in the appendix.

The trends reflected in Table 2 can be discerned more clearly in Figure 2, which depicts the percentage shares of different budget functions in total R&D funding. The increasing dominance of defense funding has already been shown in Figure 1. Figure 2 therefore concentrates on the pattern of nondefense authorizations, contrasting 1980 funding with the 1985 request.

Figure 2.

Percentage Shares of Civilian R&D Funding



[a] Includes transportation, agriculture, natural resources and environment, etc.

TABLE 2. NOMINAL AND REAL R&D BY BUDGET FUNCTION (By fiscal year, in billions of dollars of budget authority)

Budget Function	1980 a/	1984 b/	1985 c/
		Current Dollars	
Defense	15.0	29.3	37.1
Space	4.6	2.3 d/	2.7
Other Civilian			
Health	3.7	4.8	4.9
General Science	1.2	1.9	2.2
Energy	3.6	2.3	2.2
Agriculture	0.6	0.8	0.8
Natural Resources and Environment	1.0	1.0	0.9
Transportation	0.9	1.1	1.2
Other	1.1	1.1	0.9
Subtotal	12.1	13.0	13.0
Total	31.6	44.5	52.8
		1982 Dollars	
Defense	17.6	26.9	32.4
Space	5.4	2.1 d/	2.3
Other Civilian			
Health	4.3	4.4	4.3
General Science	1.5	1.7	1.9
Energy	4.2	2.1	2.0
Agriculture	0.7	0.7	0.7
Natural Resources and Environment	1.2	0.9	0.8
Transportation	1.1	1.0	1.0
Other	1.2	1.0	0.8
Subtotal	14.2	11.9	11.3
Total	37.1	40.9	46.1

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget, the National Science Foundation, and agency budget submissions to the Congress.

a. Actual.
b. Estimated.
c. Administration budget request.
d. The discrepancy between 1980 and 1984 space R&D primarily reflects the 1984 reassignment of shuttle funding from R&D to operations rather than a reduction in the overall NASA budget.

General science activities, which include National Science Foundation (NSF) programs and Department of Energy physics research, have almost doubled their share of civilian R&D funding since 1980. This trend reflects the Administration's emphasis on basic research in the civilian area as well as tight R&D budgets for other nondefense budget functions. Budget authority for general science in the 1985 budget amounts to $2.2 billion in current dollars ($1.9 billion in 1982 dollars), up from $1.2 billion ($1.4 billion) in 1980--an increase of 83 (36) percent.

Energy and space have lost the most ground in terms of their shares of total civilian R&D. In the latter case, this is somewhat misleading. Until 1984, practically all NASA funding was classified as R&D. In 1984, however, much of the space-shuttle funding was reclassified as operations rather than R&D, retroactive to 1982. NASA R&D funding therefore dropped precipitously (from $4.9 billion in 1981 to $2.6 billion in 1982), although total NASA funding has been increasing in real terms (7 percent from 1977 to 1985).

Energy-related programs have been cut substantially. Government support for energy R&D grew significantly after the 1973 oil embargo, and much of this spending was devoted to development projects. The current Administration has sought to curtail such projects, although nuclear energy R&D received relatively strong support until the 1985 request. Other energy R&D (solar, geothermal, fossil, conservation, and so forth) has been under substantial budgetary pressure, although in recent years the Congress has somewhat offset the Administration's energy R&D requests, reducing nuclear expenditures and boosting other energy funding.

Health funding has increased its share of overall nondefense R&D funding since 1980, although real funding for R&D in this budget function has fallen slightly, from $4.34 billion in 1980 to $4.29 billion in 1985. R&D funding for other civilian budget functions has gone from $3.5 billion ($4.1 billion) in 1980 to $3.7 billion ($3.2 billion) in 1985--a real decline of 22 percent. Of the major functions in this category, natural resources and environment has fared the worst, falling from $1 billion ($1.2 billion) in 1980 to $0.9 billion ($0.8 billion) in 1985, a decrease of 10 (33) percent. Spending for transportation and agriculture has been roughly constant in real terms.

Projections of R&D by Budget Function, 1985 and 1989

Projected R&D funding for 1985 and 1989, based on Administration estimates, suggest continued though dampened increases in defense-related R&D spending, a resurgence of space-related R&D, and declining real spending for other civilian activities. Actual and projected funding for

major functional categories (defense, space, and civilian) during the 1980s are presented in Figure 3.

According to these projections, defense-related R&D will exceed $51.2 billion ($37.2 billion) in 1989 (see Table 3). Projected trends in nondefense spending are illustrated in Figure 4, which may be compared to

TABLE 3. R&D SPENDING BY BUDGET FUNCTION: 1985 REQUEST AND 1989 PROJECTION (By fiscal year, in billions of dollars of budget authority)

Budget Function	1985		1989	
	Current Dollars	1982 Dollars	Current Dollars	1982 Dollars
Defense	37.1	26.9	51.2	37.2
Space	2.7	2.3	5.5	4.0
Other Civilian				
Health	4.9	4.3	5.3	3.9
General Science	2.2	1.9	2.5	1.8
Energy	2.2	2.0	2.3	1.8
Agriculture	0.8	0.7	0.8	0.6
Natural Resources and Environment	0.9	0.8	1.0	0.7
Transportation	1.2	1.0	1.2	0.8
Other	0.9	0.8	0.9	0.7
Subtotal	13.0	11.4	13.9	10.1
Total	52.8	46.1	70.0	51.2

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget and from agency budget submissions to the Congress.

Figure 2. Major increases are projected in space R&D, driven by the proposed manned space station. Space R&D is projected to increase from $2.7 billion ($2.3 billion) in 1985 to $5.5 billion ($4 billion) in 1989--an increase of 104 (74) percent.

Figure 3.

Real Federal R&D Funding, 1980-1989
(In budget authority)

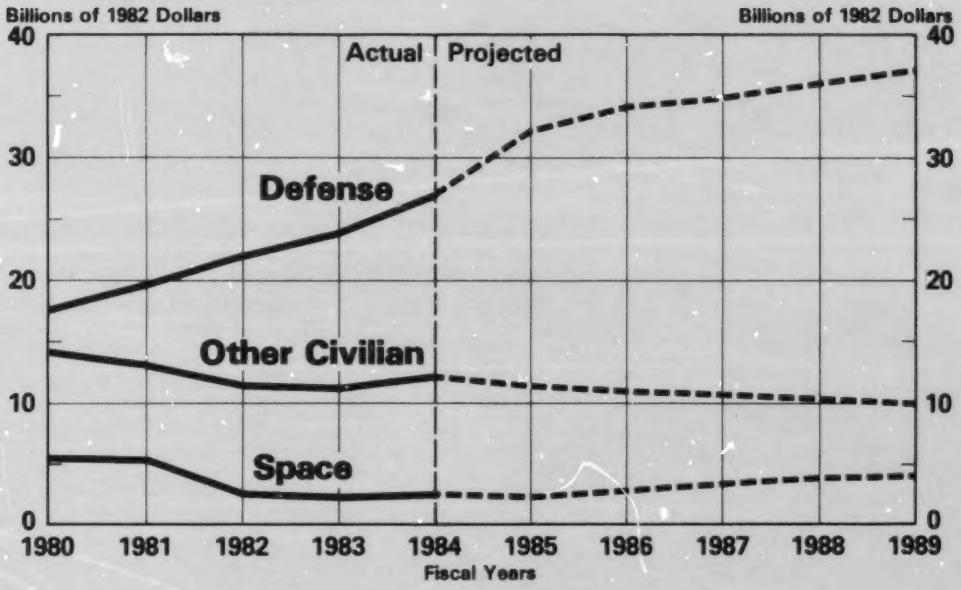
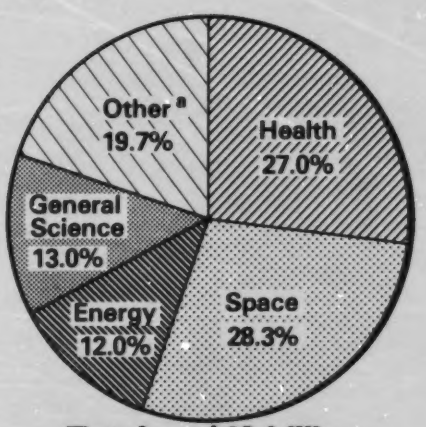


Figure 4.

Percentage Shares of Civilian R&D Funding Projected for 1989



Total = $19 billion
($14 billion in 1982 dollars)

[a] Includes transportation, agriculture, natural resources and environment, etc.

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Other civilian budget functions, however, do not fare as well. In several cases, the Administration, which projects lower outyear rates of inflation than does CBO, has frozen nominal budget authority levels, so that projected real R&D funding is reduced. Overall civilian R&D, excluding space, is projected to increase from $13 billion ($11.4 billion) in 1985 to $13.9 billion ($10.1 billion) in 1989--a nominal increase of 7 percent and a real decline of 11 percent. No civilian budget function experiences a real increase, as shown in Table 3. This is true even for general science, which enjoyed substantial growth from 1980 to 1985.

CHAPTER III. R&D FUNDING BY MAJOR AGENCY SPONSORS

This chapter discusses the R&D budgets of the ten government agencies that are the largest sponsors of R&D:

- Department of Defense (DoD),
- National Aeronautics and Space Administration (NASA),
- Department of Energy (DOE),
- National Science Foundation (NSF),
- Department of Health and Human Services (HHS),
- Department of Agriculture,
- Department of the Interior,
- Environmental Protection Agency (EPA),
- Department of Transportation (DOT), and
- Department of Commerce.

Together, these agencies account for 98 percent of total 1985 R&D funding. The chapter discusses both nominal and real funding trends for these agencies and presents estimates of real R&D funding, calculated using CBO estimates of the GNP implicit price deflator. In some cases, such as the Department of Defense, this means that the data presented here may differ slightly from those discussed in other CBO reports that use deflators specifically developed for an individual agency.

Each agency discussion concludes with a brief statement of the major policy issues raised by the agency's R&D budget. The purpose of listing policy issues is to provide themes that have been or are likely to be debated when the Congress appropriates R&D funds.

DEPARTMENT OF DEFENSE

The Department of Defense (DoD) is far and away the largest governmental source of R&D funding, accounting for two-thirds of total R&D funding in the 1985 budget and almost one-third of all the R&D--public and private--carried out in the United States. DoD activities thus have a significant influence on R&D activities in this country. By the same token, R&D plays a critical role in national security. According to the Pentagon:

> It is not efficient or necessary for our society to support a military buildup that would match the Soviets soldier-for-soldier or weapon-for-weapon. Instead we rely on superior technology and most particularly on our ability to apply that technology to fielding superior weapons systems to offset quantitative disadvantages. 1/

As one would expect, increased DoD funding is the major source of the sharp upward trend for R&D in the defense budget function described in the preceding chapter. DoD funding accounts for almost 95 percent of R&D in the defense budget function, with the remainder coming from the atomic weapons programs of the Department of Energy (DOE) and from the limited R&D programs funded by the Federal Emergency Management Agency (FEMA), which has a total R&D request of $6 million in the 1985 budget.

Overall Trends

Table 4 shows the pattern of DoD R&D funding according to the basic, applied, and development categories, although the dominant fact about R&D in the DoD budget is that all categories have increased. Defense R&D funding has increased 150 percent in nominal terms (88 percent in real) since 1980, to $35 billion ($30.5 billion in 1982 dollars) in the 1985 budget; the 1985 request is 28 (21) percent greater than 1984 funding. Development spending has increased the most, since this category comprises funding for new weapons systems. Basic and applied research have therefore lost some ground in terms of their relative shares of total DoD R&D funding, but both these categories also receive larger sums than in the previous Administra-

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1. Richard D. DeLauer, Undersecretary of Defense for Research and Engineering, Statement to the Congress, "The FY 1985 Department of Defense Program for Research, Development and Acquisition" (February 1984).

TABLE 4. DoD R&D FUNDING BY CATEGORY (by fiscal year, in billions of dollars of budget authority and in percents)

Category	1980 a/	1984 b/	1985 c/	1989 d/
		Current Dollars		
Basic	0.55	0.84	0.93	e/
Applied	1.71	2.20	2.33	e/
Development	11.55	24.36	31.69	e/
Total	13.81	27.40	34.95	51.15
		1982 Dollars		
Basic	0.65	0.77	0.81	e/
Applied	2.01	2.03	2.03	e/
Development	13.57	22.38	27.67	e/
Total	16.23	25.18	30.51	37.19
		Percentage Share		
Basic	4.0	3.1	2.7	e/
Applied	12.4	8.0	6.7	e/
Development	83.6	88.9	90.7	e/

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget and the Department of Defense budget submission to the Congress.

a. Actual.
b. Estimated.
c. Requested.
d. Projected from Administration budget submissions.
e. Not available.

tion. Since 1980, basic research has risen 69 (25) percent and applied research is up 36 (1) percent, while development has increased 174 (104) percent. Compared to 1984, real spending for applied research is constant, while both basic research and development have enjoyed real increases.

DoD's R&D budget is so massive and so complex that this discussion can do no more than suggest overall priorities and trends. Moreover, large segments of DoD's R&D programs are classified, so that funding for specific types of activities may be buried in unrevealing aggregates, spread across a variety of program elements, and/or described in terms that do not indicate the actual R&D character of the activities involved. Such defense R&D efforts as the development of the Stealth bomber cannot be identified in nonclassified budget submissions, for example.

DoD R&D funding flows through the services and through various defense agencies (the National Security Agency, the Defense Intelligence Agency, and so on). The most significant source of R&D funding among the defense agencies has traditionally been the Defense Advanced Research Projects Agency (DARPA), with a budget request of $0.7 billion in 1984. DARPA funds many of the more long-range, basic research projects that may have applications for all of the military services. Its current activities include programs in laser and particle beam research, supercomputers, and very large-scale integrated circuits. For reasons that will be described below, the 1985 budget request also ascribes several major R&D projects (totaling $1.8 billion) to the Offices of the Secretary of Defense and the Assistant Secretary of Defense--offices that funded relatively minor R&D programs in the past.

The most revealing breakdown of the DoD R&D budget describes funding in terms of functional categories, such as the technology base and strategic and tactical programs. Table 5 presents such a breakdown; it includes a residual category, "other appropriations," that represents OMB estimates of funding for DoD personnel who carry out R&D. Table 6 describes the 1985 pattern of functional R&D funding by the services and agencies that make up DoD. The figures presented in Table 6 do not exactly correspond to the data in Tables 4 and 5 because of slight differences in the ways that DoD and OMB calculate DoD defense R&D spending.

DoD R&D Funding by Functional Categories

Technology Base. Among the functional categories, activities related to the technology base have experienced the slowest rate of growth,

TABLE 5. DoD R&D FUNDING BY FUNCTION (By fiscal year, in billions of dollars of budget authority)

Function	1980 a/	1984 b/	1985 c/
		Current Dollars	
Technology Base	2.27	3.04	3.23
Advanced Technology Development	0.6	1.39	3.42
Strategic Programs	2.17	7.84	8.74
Tactical Programs	5.23	7.91	10.51
Intelligence and Communications	1.15	3.40	4.22
Defense-wide Mission Support	1.93	3.28	3.88
Other Appropriations	0.47	0.53	0.95
Total	13.81	27.40	34.95
		1982 Dollars	
Technology Base	2.67	2.79	2.82
Advanced Technology Development	0.71	1.28	2.99
Strategic Programs	2.55	7.20	7.63
Tactical Programs	6.15	7.27	9.18
Intelligence and Communications	1.35	3.12	3.68
Defense-wide Mission Support	2.27	3.01	3.39
Other Appropriations	0.55	0.49	0.83
Total	16.23	25.17	30.51

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget and Department of Defense Budget for Fiscal Year 1985, "R, D, T&E Programs (R-1)," February 1, 1984.

a. Actual.
b. Estimated.
c. Requested.

TABLE 6. FUNCTIONAL R&D FUNDING BY DoD SERVICES AND AGENCIES, FISCAL YEAR 1985 (In billions of dollars of budget authority and in percents)

Function	Army	Navy	Air Force	OSD a/	DARPA b/	Other c/	Total
				In Billions of Dollars			
Technology Base	0.79	0.83	0.78	---	0.69	0.14	3.23
Advanced Technology Development	0.56	0.29	0.58	1.79	---	0.20	3.42
Strategic Programs	0.23	2.38	6.07	---	---	0.06	8.74
Tactical Programs	2.33	5.22	2.95	---	---	---	10.51
Intelligence and Communications	0.07	0.42	2.02	---	---	1.71	4.22
Defense-wide Mission Support	1.02	0.69	2.00	0.06	0.03	0.08	3.88
Total	4.99	9.83	14.40	1.85	0.71	2.19	34.00
				Percentage Share d/			
Technology Base	24	26	24	---	21	4	100
Advanced Technology Development	16	8	17	52	---	6	100
Strategic Programs	3	27	69	---	---	1	100
Tactical Programs	22	50	28	---	---	---	100
Intelligence and Communications	2	10	48	---	---	41	100
Defense-wide Mission Support	26	18	52	2	1	2	100

SOURCE: Department of Defense Budget for Fiscal Year 1985, "R, D, T&E Programs (R-1)," (February 1, 1984).

a. Office of Secretary of Defense.
b. Defense Advanced Research Projects Agency.
c. Defense Mapping Agency, National Security Agency, Defense Nuclear Agency, Defense Information Agency, etc.
d. Defense service or agency funding as a percent of total function funding.

compared to both 1980 and 1984. These activities make up 9 percent of the DoD R&D budget, down from 16 percent in 1980. Technology-base programs refer to two types of activities. First, this category includes basic research projects that are not directly related to explicit military objectives. Such support is justified on the grounds that a strong scientific base is needed to ensure that resources and expertise will be available to fulfill future national security needs. All DoD funding for basic research (which is distributed across the scientific spectrum, emphasizing the hard sciences) is included in the technology-base category. DoD is the fourth-largest federal sponsor of basic research, after HHS, NSF, and DOE. Second, the technology-base category also includes the application of new technologies to defense uses--activities that are conventionally referred to as applied research.

Advanced Technology Development. The advanced technology development category contains both programs with potentially significant spillover benefits for the civilian economy and programs with a strong military orientation. Real funding for this category in the 1985 budget is $3.4 billion ($3 billion), 146 (134) percent above the 1984 level and 470 (320) percent above the 1980 level. Advanced technology development programs with obvious civilian applications include Air Force funding for R&D in very high-speed integrated circuits ($120 million, the same as in 1984) and in automated manufacturing systems. DoD is strongly committed to developing these technologies in order to reduce the time needed to bring new technologies to operational deployment. DoD also provides significant funding for advanced technology development in computer software. In the 1985 budget, the Army has requested $21 million for a new program, Software Technology for Adaptable Reliable Systems (STARS), that is projected to receive $53 million in 1986. This program builds upon the Air Force Ada program (funded at $8 million in 1985), which is developing a standardized DoD computer language. The Army budget also provides $8 million for R&D in artificial intelligence and robotics, while the Navy requests $11 million for advanced computer technologies. Such programs are also supported by the supercomputer efforts funded by DARPA.

Advanced technology development with a more immediate military application includes a major new initiative announced by President Reagan last March. This involves the development of antiballistic missile defense capabilities, including space-based weapons; within DOD these programs are referred to as "Strategic Defense Initiatives." Largely because of interservice rivalries, existing programs in these areas were pulled from the services and defense agencies and placed directly under the Office of the

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Secretary of Defense (OSD). The 1985 budget provides $1.8 billion for the programs that make up Strategic Defense Initiatives, including $721 million for surveillance, acquisition, and tracking; $489 million for directed energy particle-beam R&D; and $356 million for conventional weapons R&D. According to DoD, this total, drawn from programs formerly managed by other branches of DoD, includes a $250 million increase over the 1984 level. Funding for Strategic Defense Initiatives is projected to increase to $3.8 billion in 1986. DoD budget projections suggest that these programs could receive $22-$27 billion over the next five years, an increase of up to 50 percent over projections based on the 1984 budget submission. The reported decrease in DARPA funding (from $864 million in 1984 to $715 million in 1985) is probably a result of this administrative reclassification. It is as yet unclear how OSD will interact with the services and the defense agencies in managing the Strategic Defense Initiatives Program, especially as the program becomes more clearly defined.

Strategic. Funding for strategic programs, which comprise long-distance (generally nuclear) weapons, has been increased by $0.9 billion in 1985 to a total of $8.7 billion--11 percent in nominal terms (6 in real) above the 1984 level and 300 (200) percent above the 1980 level. Funding for this category is projected to decline by $0.7 billion in 1986. As Table 6 shows, the Air Force is by far the largest source of funding for R&D in strategic programs. The major program in this area is the Air Force's ICBM modernization (the MX program), which is funded at $2.4 billion, about the same level as in 1984. Other major Air Force strategic programs include the B1-B bomber (funded at $0.5 billion in 1985, down from $0.7 billion in 1984), space defense systems (funded at $195 million, down from $251 million), and the MILSTAR SATCOM communications system (funded at $325 million, up from $148 million). In addition, $54 million is provided for the definition stage of a new advanced air-to-surface missile. Funding for this program is projected to increase to $148 million in 1986.

The Navy's major strategic program is the Trident II missile, which is funded at $2.1 billion, up from $1.5 billion in 1984. By Navy and Air Force standards, Army funding for strategic programs is more limited, totaling $0.2 billion in 1985.

Tactical. All the services provide substantial funding for tactical programs. Some of the most significant in the 1985 budget are:

- The Air Force advanced tactical fighter aircraft, funded at $94 million, up from $35 million in 1984, and projected to require $250 million in 1986;

- The Air Force fighter derivative, which according to current plans involves upgrading the F-15 to perform both attack and fighter functions; funded at $147 million in 1985, up from $19 million in 1984, and projected to require $244 million in 1986;

- The Air Force C-17, which provides a smaller cargo alternative to the C-5; funded at $129 million in 1985, up from $27 million in 1987, and projected to require $364 million in 1986;

- The Navy F-14A fighter aircraft, funded at $294 million, up from $42 million in 1984, and projected to require $543 million in 1986; and

- The Army antitactical missile, funded at $92 million, up from $17 million in 1984 and projected to require $91 million in 1986.

At the same time that funding for these projects is increasing, however, R&D funding is winding down for some tactical programs that are nearing the procurement stage, such as the Navy's Tomahawk missile program.

DoD also funds R&D efforts associated with several joint tactical projects. These include the Army/Air Force Joint Tactical Missile system, funded by the Army at $79 million, up from $50 million in 1984 and projected to require $119 million in 1986. Another such effort is the Joint Tactical Information Distribution System (JTIDS), to which all the services contribute and which is funded at $240 million in 1985, up from $173 million in 1984 and projected to require $258 million in 1986. JTIDS represents an effort to develop secure communications systems able to endure in wartime conditions. Finally, the Joint Service Advanced Vertical Lift Aircraft (JVX) is a joint program designed to develop a hybrid helicopter/airforce aircraft. The Navy requests R&D funds of $198 million for this project in 1985, up from $87 million in 1984, and projected to increase to $619 million in 1986; the Air Force requests much smaller JVX funding.

Intelligence and Communications. The intelligence and communications category contains R&D projects funded mainly by the Air Force and by defense agencies such as the Defense Intelligence Agency. Since the bulk of these programs are classified, funding levels are not broken out for specific programs.

Defense-wide Mission Support. Finally, defense-wide mission support involves a wide variety of programs, with major funding provided by each of the services. Much of this funding is spent on weapons testing and the maintenance of testing facilities.

The information presented above only partially describes the structure of DoD R&D funding. Because of the classified nature of many of these programs, the information available in a format such as this is inevitably incomplete.

Major Policy Issues

The Effects of Rapid R&D Increases. The major issue raised by the large and rapid increases in the DoD R&D effort concern the department's ability to use this new budget authority efficiently. This question applies both in the aggregate and to individual defense programs. In general, defense spending appears to be no more prone to increasing "bottlenecks" in the economy than does other government spending on goods and services. 2/ But defense R&D activities might call for highly specialized equipment and manpower resources that could be in relatively fixed supply in the medium-term. Some analysts feel that the defense R&D buildup might risk diverting qualified scientists and engineers from other activities in private industry and academic institutions. This might be particularly true for physicists, given the new emphasis on particle-beam weaponry. A shortage of scientists or engineers in a given area might persist for several years, in view of the lead times necessary to acquire this training.

Little direct evidence is available, however, about these possible effects. While DoD's sizable role in the national R&D effort (one-third of all U.S. R&D as measured by funding) means that some interaction between military and civilian research is inevitable, sustained increased defense funding would attract more people into needed occupations in the long run. Moreover, although DoD R&D outlays have kept pace with funding authority, bottlenecks have not yet been observed to impede the predicted expansion of DoD's R&D outlays.

Strategic Defense Initiatives. The Strategic Defense Initiatives program comprises advanced technology development, including funding for the research needed to develop a missile defense system based on the deployment of particle-beam satellites. This program raises a variety of issues--including its technical feasibility, its effect on the arms race and the militarization of space, and its consonance with existing anti-ballistic missile treaties--that are beyond the scope of this paper. Strong Administration support makes it likely that this program will be a major policy issue and, potentially, dominate DoD's R&D efforts in the future.

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2. See Congressional Budget Office, Defense Spending and the Economy (February 1983).

Technology Base. DoD's technology-base programs have received the smallest increase of all categories of DoD R&D. These programs support the use of state-of-the-art technology among defense goods manufacturers and the fundamental research needed to maintain the technological advantage of the U.S. military. The defense technology base plays a long-term role in military preparedness. Should the Congress reduce the DoD budget as it did in 1984, R&D cuts are more likely to occur in the technology-base area than in weapons systems. This might have a significant impact on DoD university funding and the scientific infrastructure that supports DoD efforts. On the other hand, these programs may be worthwhile candidates for budget reductions, given their indirect relationship to existing weapons programs. Eliminating development funding, instead, could lead to the termination or deferral of current weapons program.

Selecting Research Results for Development. Research programs are much less expensive than the development and procurement activities that follow up on successful research. DoD now funds more research programs than it could finance at more developed stages, in the hope of creating a diverse scientific base from which new weapons can be selected. Because of the speculative nature of research projects, a strong argument can be made for funding a wide range of long-term projects. At the same time, however, this implies that only the most promising of these projects should be pursued at the later, more expensive stages of the R&D process. Unless enough discipline is placed on the weapons development process, current R&D expenditures could become precursors to higher weapons development budgets in the future.

Civilian Applications. Technological advances promoted by the DoD often carry the possibility of successful civilian applications. The aviation and semiconductor industries, for example, are two cases of successful civilian industries whose early research agendas, including major elements of civilian design, were funded by the military. Expansion of DoD's technology transfer activities might help to compensate for the decline in real federal R&D funding for civilian applications. On the other hand, those firms that produce defense goods, such as electronic component or engine manufacturers, may already have the ability to apply defense-related know-how to civilian products. Moreover, while many leading civilian industries have technological ties to military R&D, much military R&D is specialized and has little if any civilian application.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Table 7 describes the National Aeronautics and Space Administration (NASA) R&D funding patterns during the 1980s. 3/ After a substantial decrease in R&D funding in 1984 when space shuttle programs were shifted to operations, major increases are projected through the rest of this decade. This growth is attributed to the effort to develop a manned space station by the first half of the 1990s.

Since the space shuttle entered operations in 1984, NASA has not had a major R&D project on the order of Apollo or the shuttle. The space station is such a project. In 1984, about $14 million was devoted to preliminary definition of the space-station project. The program officially starts in 1985, when funding begins at the relatively low level of $150 million for project definition. By 1987, however, as the project moves toward the development stage, expenditures begin to increase rapidly, reaching $2.1 billion in 1989 (see Table 8).

NASA projects that total funding for the space station through 1989 will be $5.4 billion in nominal dollars and that the total cost of the project will be $11 billion, or an estimated $8 billion in 1984 dollars. These estimates are highly provisional; firmer figures will not be available until the project-definition stage is much further along. Projects like the space station are frequently characterized by cost overruns, although NASA contends that the modular design of the space station will enable the agency to meet cost projections.

NASA funding for other space R&D amounts to $2.44 billion in 1985, up from $2.35 billion in 1984--a slight real decrease of 1 percent. Over 80 percent of the 1985 total is for space science, applications, and technology programs which include:

- Physics and astronomy, such as the space telescope--$0.86 billion;
- Life sciences--$0.09 billion;

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3. Throughout this report, the data for NASA R&D funding comprise actual R&D funds as well as some portion of "Research and Program Management." In general, NASA describes contract R&D as R&D and intramural R&D as part of Research and Program Management. The R&D totals discussed in this report include both categories and are allocated to different activities and projects according to NASA's own estimates.

TABLE 7. NASA R&D FUNDING BY CATEGORY (By fiscal year, in billions of dollars of budget authority and in percents)

Category	1980 a/	1984 b/	1985 c/	1989 d/
		Current Dollars		
Basic	0.56	0.69	0.83	e/
Applied	1.05	1.01	1.09	e/
Development	3.48	1.19	1.42	e/
Total	5.08	2.89 f/	3.33	6.2
		1982 Dollars		
Basic	0.66	0.63	0.72	e/
Applied	1.24	0.93	0.95	e/
Development	4.08	1.09	1.24	e/
Total	5.97	2.66	2.91	4.5
		Percentage Share		
Basic	11.0	23.9	24.8	e/
Applied	20.7	35.0	32.6	e/
Development	68.4	41.1	42.7	e/

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget and the NASA budget submission to the Congress.

a. Actual.
b. Estimated.
c. Requested.
d. Projected from Administration budget submissions.
e. Not available.
f. This reduction reflects the reclassification of the space shuttle from R&D to operations. The overall NASA budget, which prior to this reclassification was almost completely R&D, did not decline.

TABLE 8. SPACE STATION FUNDING (By fiscal year, in millions of dollars of budget authority)

Stages	1985	1986	1987	1988	1989
Project Definition	150	280	254	---	---
Development	---	---	996	1,650	2,070
Total	150	280	1,250	1,650	2,070

SOURCE: "National Aeronautics and Space Administration FY 1985 Budget Summary," submitted to the Congress, February 1984.

- Planetary explorations, such as the Galileo mission to Jupiter--$0.3 billion;
- Space applications, such as environmental observations--$0.47 billion;
- General space research and technology, maintaining the space-science base--$0.27 biilion; and
- Technology utilization--$13.4 million.

Funding for space science, applications, and technology in the 1985 budget is up 7 percent in nominal terms (2 percent real) from the 1984 level. These activities have enjoyed significant growth in recent years--27 (15) percent since 1983. In nominal terms, requested 1985 funding exceeds the 1984 level for all three categories. In real terms, funding for technology utilization has held constant, while all other categories have gone up. Funding increases are greatest in the planetary exploration category, which is up 23 percent in real terms over the 1984 level. Funding for planetary explorations has been somewhat controversial in recent years; its proponents argue that NASA funding has favored physics and astronomy over solar-system research. In general, funding for scientific programs had been cut in the early 1980s because of the priority given to launching the shuttle.

The 1985 budget includes several new space-science programs, including:

- The Mars Geoscience Climatology Orbiter, funded at $56.1 million in 1985. This project has an estimated total cost (in 1985 dollars) of $300-$375 million, with an expected 1990 launch date. Its purpose is to provide data concerning the geophysical and geochemical nature of Mars, especially near its polar regions.

- The Upper Atmospheric Research Satellite, funded at $68.7 million in 1985. This project has an estimated total cost (in 1985 dollars) of $630-$670 million, with an expected 1989 launch date. Its purpose is to provide data about the molecular properties of the upper atmosphere, information that will contribute to improved weather forecasting and to the resolution of questions concerning environmental changes that may have significant long-term effects.

- The scatterometer on the Navy Remote Ocean Sensing Satellite, with NASA funding of $15 million in 1985. The project will cost an estimated total of $120-$130 million (in 1985 dollars), with an expected 1988 launch date. The Navy will pay for most of this satellite project. Its purpose is to improve the Navy's monitoring of ocean conditions and to carry out ocean research.

The other major category of NASA R&D funding is aeronautical R&D, a role that stems from the activities of NASA's predecessor agency, the National Advisory Committee on Aeronautics. Once skeptical of government funding for aeronautical R&D, the Administration now supports such projects, even though they are similar to the kinds of commercially oriented R&D that the Administration views as the responsibility of the private sector in other sectors of the economy. 4/ Aeronautical R&D is funded at $0.66 billion in the 1985 request, up from $0.6 billion in 1984. This represents an increase of 10 (5) percent. By 1989, funding for aeronautical projects is expected to reach $0.75 billion, an increase of 14 percent in nominal terms and a decrease of 5 percent in real terms compared to the 1985 request. NASA's aeronautical R&D projects comprise aircraft design, flight simulation, air safety, fuel efficiency, reductions in aircraft noise, and so on.

Finally, the NASA budget includes significant funding--$3.3 billion--for shuttle operations, in addition to a smaller amount ($0.5 billion) for shuttle-related R&D. In 1984, the Administration reclassified much of the shuttle project as operations rather than as R&D, retroactive to 1982. This

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4. See Office of Science and Technology Policy, Aeronautical Research and Technology Policy (November 1982).

caused a sharp drop in the NASA R&D budget, but overall NASA spending did not decline, nor was there any significant deviation from the projected course of NASA activities. Budget authority for shuttle operations is projected to decline to $2.1 billion in 1989, a drop of about 35 (47) percent from the 1985 level. Reduced funding for the shuttle is predicated on increased revenues from the leasing of shuttle space to private enterprise.

The Administration has projected 1 percent real growth in the overall NASA R&D budget through 1989, above and beyond the new starts included in the 1985 request. This provides the agency with a funding wedge that can be allocated to future projects or to additional costs for existing projects.

Major Policy Issues

Space Station Costs. Funding for the space station amounts to only $150 million in 1985, but is projected to exceed $2 billion in 1989. Commitment of resources to this project, therefore, deserves careful scrutiny. 5/ NASA projections of the funding needed for the space station will be highly speculative until the project-definition stage is much further advanced.

NASA projections of the space stations' cost do not reflect the eventual cost of operating and maintaining it once it is in place. For example, additional equipment (such as an orbiting, maneuvering vehicle) will be needed to fulfill the station's mission, and such add-ons are likely to increase the project's total cost.

Possibility of Revenue Shortfalls. NASA funding projections are predicated on increased revenues from shuttle operations and on the accuracy of estimated out-year spending for the space station. The space shuttle, however, could face growing competition from foreign space programs and from civilian space services in delivering payloads. If shuttle revenues should fall short of NASA expectations or the space station encounter cost overruns, significant shortfalls would result in NASA programs. Policymakers might wish to assess this risk and ascertain how NASA would deal with inadequate shuttle revenues or space-station cost overruns.

Effects of International Cooperation. Because of the recent entry of foreign and private-sector alternatives, NASA now functions in a radically

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5. See the statement by Dr. John Gibbons, Director of the Office of Technology Assessment (OTA), before the Senate Budget Committee, February 27, 1984. OTA is currently preparing a report on space stations.

different environment from the one it occupied for the first decades of its existence. New foreign capability raises the possibility of greater commitment to international cooperation, which might be one means of reducing the U.S. costs of the space station. On the other hand, internationalizing this program might compromise its potential military benefits and would disseminate its technology findings to foreign competitors.

DEPARTMENT OF ENERGY

The Department of Energy's (DOE) 1985 budget request provides $5.0 billion for R&D, $159 million above the 1984 level, but still 2 percent lower in real terms. 6/ The 1985 request therefore continues the Administration's long-standing effort to reduce federally funded energy R&D. Moreover, the 1985 request reproduces the general patterns established by the Administration's previous DOE budgets: increased funding for defense-related programs, increased commitment to basic research in civilian programs, and reduced funding for other categories of civilian energy R&D. Since 1980, overall DOE R&D funding has declined 23 percent in real terms, from $5.6 billion in 1980 to $4.3 billion in 1985. With the exception of NASA, where the R&D budget was reduced sharply by the reallocation of the space shuttle from R&D to operations, no government agency has experienced a greater reduction in R&D funding than DOE. After discounting DOE's defense-related programs, these changes are even more noticeable.

Table 9 describes the overall pattern of DOE R&D funding, aggregating defense and nondefense programs. In general, the DOE R&D budget for 1985 contains the following elements:

- Basic research increases 18 percent in nominal terms (13 percent in real) over 1984 levels, from $1.04 billion to $1.23 billion. Basic research now accounts for 25 percent of DOE R&D, up from 11 percent in 1980.

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6. The estimates discussed in this section are based on program-level data provided by DOE's Budget Office. For 1984 and 1985, DOE's budget data do not conform to the estimates used by the Office of Management and Budget (OMB), probably because of discrepancies in the classification of some DOE defense programs and the treatment of some capital-equipment and construction programs. At the time this report was prepared, the differences between OMB's compilation and DOE's budget submission to the Congress had not been resolved.

TABLE 9. DOE R&D FUNDING BY CATEGORY (By fiscal year, in billions of dollars of budget authority and in percents)

Category	1980 a/	1984 b/	1985 c/	1989 d/
		Current Dollars		
Basic	0.52	1.04	1.23	e/
Applied	0.75	1.53	1.61	e/
Development	3.51	2.25	2.12	e/
Total	4.78	4.81	4.97	5.7
		1982 Dollars		
Basic	0.61	0.96	1.08	e/
Applied	0.88	1.40	1.41	e/
Development	4.12	2.06	1.85	e/
Total	5.61	4.42	4.34	4.1
		Percentage Share		
Basic	10.9	21.6	24.8	e/
Applied	15.7	31.8	32.4	e/
Development	73.3	46.8	42.7	e/

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget, the DOE budget submission to the Congress, and data provided by the DOE Budget Office.

a. Actual.
b. Estimated.
c. Requested.
d. Projected from Administration budget submissions.
e. Not available.

- Applied research is $86 million above the 1984 level, a 6 percent boost (reflecting roughly constant real funding) that can be ascribed to increased defense applied research. Civilian applied research funding is down 3 percent in real terms from 1984.

- Total development funding decreases $210 million, despite an increase of $10 million for defense development activities. Civilian development programs have been reduced 20 (24) percent from the 1984 level.

- Defense programs continue to be favored in the 1985 budget request. In 1980, such activities accounted for 24 percent of total R&D funding, while in 1985 they make up 40 percent of the DOE total.

These trends have been justified on the grounds that the private sector will adequately finance applied research and development in near-term energy technologies, particularly in renewable energy programs (for example, solar, fossil, geothermal), while the public sector is responsible for defense and for long-term energy R&D, especially in nuclear energy. Moreover, given continued softness in world oil markets, the impetus for many energy programs may have weakened.

Nevertheless, the 1985 budget seems to reflect some change in the Administration's stance toward civilian energy R&D--especially when compared with previous budget requests. In the past, the Administration has sought to shift civilian energy R&D funding toward nuclear programs and away from R&D in fossil fuels, renewable energy, and conservation. The Congress has typically cut the funding requested for nuclear energy R&D while restoring funds in other areas. The 1985 request reduces support for nuclear energy, partially because the Clinch River Breeder Reactor has been terminated, while alternative energy sources and conservation have been spared the significant cuts requested in 1984.

Defense R&D

The DOE defense programs, all of which relate to defense applications of atomic energy, are given impetus by the Administration's support for increased defense spending and can, therefore, be treated separately from DOE's other activities. This convention is followed in Tables 10 and 11, which break down DOE R&D on a programmatic basis. (Table 10 data are in current dollars and Table 11 data are in 1982 dollars.) All the major categories of DOE's defense programs have received increased real funding in the 1985 request over 1984, including:

TABLE 10. NOMINAL DOE R&D BY TYPE AND CATEGORY, FISCAL YEARS 1980, 1984, AND 1985 (In millions of current dollars of budget authority)

	1980 a/			1984 b/			1985 c/		
	Basic Research	Applied Research	Develop-ment	Basic Research	Applied Research	Develop-ment	Basic Research	Applied Research	Develop-ment
Military									
Atomic Energy for Defense	0	178	955	2	608	1,246	4	675	1,323
Civilian									
General Science and Basic Energy Sciences d/	518	18	0	979	4	0	1,170	6	0
Nuclear Fission e/	2	23	976	0	18	712	0	17	602
Nuclear Fusion	0	174	61	0	392	0	0	413	0
Fossil Fuels	0	76	652	34	168	81	26	140	54
Solar and Geothermal	1	47	500	0	104	93	0	131	51
Conservation	0	15	348	0	76	113	0	77	93
Biological and Environmental	0	154	0	25	157	0	31	155	0
Total, Civilian	522	572	2,550	1,038	921	999	1,227	939	800
Total	522	750	3,505	1,040	1,528	2,245	1,231	1,614	2,123

SOURCE: Congressional Budget Office from U.S. Department of Energy, Budget Office data (February 13, 1984).

NOTE: Excludes capital equipment and construction costs, except in "General Science and Basic Sciences."

a. Actual.
b. Estimated.
c. Requested.
d. Includes university research support and instrumentation.
e. Includes uranium enrichment ($141 million in the 1985 request) for which the government is supposed to be reimbursed through fees paid by utilities.

TABLE 11. REAL DOE R&D BY TYPE AND CATEGORY, FISCAL YEARS 1980, 1984, AND 1985 (In millions of 1982 dollars of budget authority)

	1980 a/			1984 b/			1985 c/		
	Basic Research	Applied Research	Develop-ment	Basic Research	Applied Research	Develop-ment	Basic Research	Applied Research	Develop-ment
Military									
Atomic Energy for Defense	0	209	1,122	2	559	1,145	3	589	1,155
Civilian									
General Science and Basic Energy Sciences d/	609	21	0	899	4	0	1,022	5	0
Nuclear Fission e/	2	27	1,147	0	17	654	0	15	526
Nuclear Fusion	0	204	72	0	360	0	0	361	0
Fossil Fuels	0	89	766	31	154	74	23	122	47
Solar and Geothermal	1	55	588	0	96	85	0	114	45
Conservation	0	18	409	0	70	104	0	67	81
Biological and Environmental	0	181	0	23	144	0	27	135	0
Total, Civilian	613	672	2,996	953	846	918	1,071	820	698
Total	613	881	4,118	955	1,403	2,063	1,075	1,409	1,853

SOURCE: Congressional Budget Office from U.S. Department of Energy, Budget Office data (February 13, 1984).

NOTE: Excludes capital equipment and construction costs, except in "General Science and Basic Sciences."

a. Actual.
b. Estimated.
c. Requested.
d. Includes university research support and instrumentation.
e. Includes uranium enrichment ($123 million in the 1985 request) for which the government is supposed to be reimbursed through fees paid by utilities.

- An additional $77 million for weapons research development and testing, an increase of 7 (2) percent;

- An additional $56 million to support ongoing nuclear propulsion and reactor-core development for naval vessels, an increase of 16 (10) percent.

- An additional $4 million to fund analyses of arms control, export control, and nuclear weapons and proliferations issues, an increase of 20 (15) percent.

- An additional $14 million for improving methods for the safe disposal of defense-related nuclear wastes, an increase of 14 (9) percent; and

- An additional $8 million for nuclear safeguards and security, including continued development of computer security systems to protect classified information, an increase of 20 (15) percent.

Civilian R&D

The civilian section of Table 10 illustrates the priorities mentioned above. Basic research funding receives relatively strong support, while other categories are cut. In addition, nuclear energy projects have been subject to smaller cuts than other energy R&D, although the difference is far smaller than in the Administration's previous budget requests. These priorities are consistent with the Administration's previous budget requests for DOE R&D.

Science. Funding for general science and basic energy science programs (including support for university research) has been increased 17 (12) percent over the 1984 level, to a total of $1.2 billion ($1.0 billion). 7/ These programs are dominated by advanced physics research. High-energy physics research funding has risen from $480 million in 1984 to $561 million in 1985--a real increase of 10 percent. Funding increases are primarily devoted to increased utilization of existing facilities, ongoing work on construction projects, and increased capital equipment for projects currently underway. The facilities supported by such funding include a variety of

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7. R&D funding in this category includes construction and capital equipment expenses. This is one source of the discrepancy between OMB and DOE figures.

sophisticated projects: the Energy Saver Superconducting Synchrotron at Fermilab, the Stanford Linear Collider, and the Tevatron projects at Fermilab.

Funding for nuclear physics also increases at a real rate of 10 percent, from $159 million in 1984 to $183.6 million in 1985. In this case, new funding is devoted to maintaining utilization of the national accelerator facilities at 90 percent of the 1984 levels, completion of Tandem/AGS Heavy Ion transfer line project, and groundbreaking for the Continuous Electron Beam Accelerator facility.

Two new starts in DOE's general science program may be particularly worthy of Congressional attention:

- o $5 million has been allocated for a new high-energy, continuous electron beam accelerator at Newport News, Virginia. This represents the establishment of a new national laboratory, a fact that has generated some controversy within the physics community. 8/ Total estimated construction costs for this project amount to $200-225 million.

- o $20 million has been allocated for preliminary R&D for the Superconducting Supercollider, a proton-proton collider. Last summer, DOE's High-Energy Physics Advisory Board gave this project highest priority, indirectly endorsing the termination of the Brookhaven National Laboratory's half-finished Colliding Beam Accelerator, a smaller facility. Total costs of the new project are likely to amount to a minimum of $2 billion. 9/

Nuclear Energy. Funding for fission research has been reduced from $731 million ($671 million) in 1984 to $619 million ($540 million), a drop of 15 (20) percent. This represents a shift in Administration energy policy, since nuclear-fission R&D had received relatively strong support in the Administration's previous budget requests. The 1985 request reflects the termination of the Clinch River Breeder Reactor, which will require an estimated $123 million to be shut down. The remaining funds for breeder reactor R&D ($5 million for applied research and $270 million for develop-

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8. See "Peace at Hand for Nuclear Physics," Science, vol. 221 (August 5, 1983).

9. See "Gambling on the Supercollider," Science, vol. 221 (September 9, 1983).

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ment) will be channelled into assisting the private sector in developing future plants.

Funding for fusion has been increased $21 million above the 1984 level, to $413 million. This increase will finance the operation of the Tokamak Fusion Test Reactor at Princeton. In addition, funding is provided for the continued construction of the Mirror Fusion Test Facility-TS at Lawrence Livermore National Laboratory, the largest tandem mirror scaling experiment in the world. Together, these two confinement systems are considered the closest to producing the reactor-grade plasmas needed for a sustained fusion reaction.

Funding for R&D in nuclear-waste technology has been decreased by $1 million, though funding for generic civilian-waste R&D has more than doubled to $18.8 million in 1985 over 1984.

Fossil Fuels. Fossil fuel programs continue to receive reduced funding in DOE's new R&D budget. Overall, the 1985 budget requests $220 million for fossil R&D, down from $282 million in 1984--a decrease of 22 (26) percent. With the inclusion of deferrals from previous years, however, the 1984 program level for fossil R&D is approximately $322 million. Since 1980, real funding for fossil R&D has fallen 77 percent. This trend has several sources: reduced concern about energy supply, Administration skepticism about federal funding of commercially oriented R&D, and the completion of some demonstration projects.

Compared with 1984, funding for coal R&D decreased 32 (35) percent in 1985 to $64 billion, with major cuts in fuel cells R&D, magnetic-hydrodynamics research, and coal liquification. Reduced coal funding reflects increased skepticism about the potential of synthetic fuels (synfuels), whose development is to be funded by the Synfuels Corporation, an off-budget entity designed to provide loan and price guarantees for private synfuels projects. Increased acid-rain research is the one area of coal R&D that receives increased funding. Petroleum R&D receives a 4 (-1) percent increase, most of which will be channelled to exploratory research in Artic and offshore areas. Gas R&D is cut 42 (48) percent, down to a total of $10 million; all programs other than those relating to methane hydrates have been eliminated.

Renewable Energy. Overall funding for renewable or alternative energy R&D has been reduced 8 (12) percent in the 1985 request, to a total of $182 million. Relative to 1984, the 1985 reduction is actually smaller than the Administration had proposed for renewable energy R&D in its previous budgets. Compared with 1980, however, the 1985 request represents a 67 (76) percent decrease. Solar programs dominate renewables R&D,

amounting to $156 million ($136 million) in 1985, down from $167 million ($153 million) in 1984 and $409 million ($481 million) in 1980.

Major 1985 reductions from 1984 include:

- Solar-building energy systems decrease 29 percent (33 percent) to $12 million, particularly in materials and component development and heat transfer systems analysis.

- Wind energy programs are cut by 13 percent (17) to $23 million. Mod-5 multi-megawatt turbine development and large-scale wind turbine cluster testing and development were most seriously affected.

- Ocean energy systems decrease 36 percent (40) to $3.5 million. Thermodynamics and experimental verification suffered the largest cuts.

- Hot dry rock research, a geothermal energy source funded at $5.5 million, is 27 percent (31) lower than in 1984.

- Hydrothermal research decreases 13 percent (17) to $9.9 million. This is accounted for by reduced funding for deep-well drilling.

Conservation

Funding for overall conservation R&D programs decreases 10 percent (15 percent) to $170 million ($148) from 1984 to 1985. Conservation R&D has incurred major cutbacks since 1980. Over the five-year period, funding decreased 53 (65) percent. Although the percentage cuts in the 1985 request are less severe than previous Administration requests, clearly the Administration would prefer the private sector to fund conservation programs. Major cuts include:

- A 9 percent (13) decrease to $33 million for buildings and community systems R&D;

- A 14 percent (19) decrease in industrial conservation R&D; and

- A 33 percent (37) decrease in transportation conservation R&D.

Major Policy Issues

Funding Commercial Development. The Administration has effected major changes in the kinds of energy R&D the government supports, and this will probably remain a contested issue. The Administration's programs would gradually phase out activities that it thinks should be the responsibility of the private sector. This process, however, could be accelerated. Eliminating federal funding for commercially oriented energy R&D could save the government $600 million in 1985 and a cumulative total of $3.6 billion from 1985 to 1989. 10/ Doing so, however, would slow the development of energy technologies that could help reduce long-term vulnerability to foreign oil supply disruptions.

Balance Among Energy Technologies. Previous Administration energy R&D budgets have favored nuclear R&D over activities fostering other forms of energy. Such a bias could skew the rate at which different forms of energy become commercially available, a point that might be particularly relevant given the serious economic problems currently confronting commercial nuclear power plants. Imbalances in R&D support for energy technologies could hinder the development of some potentially attractive energy alternatives. On the other hand, some alternative energy technologies (for example, solar or conservation) may be close to commercialization, while many nuclear technologies (fusion, for example) are still far from that stage. Moreover, research in nuclear technologies involves larger projects that are more difficult for any one firm to support, and may contribute to other national goals, such as curbing the potential for nuclear weapons proliferation or managing civilian nuclear wastes.

Support for Science Facilities. New laboratory facilities often involve some conflicts between scientific considerations and funding constraints. Some have argued that new facilities should be placed at existing national labs in order to use existing infrastructures, although valuable scientific proposals may be developed by groups outside the current national laboratory system. In addition, current plans call for major expenditures for the superconducting supercollider. If approved, this project will require significant increases in DOE's science R&D budget or decreases in other DOE programs in future years.

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10. See Congressional Budget Office, Reducing the Deficit: Spending and Revenue Options (February 1984), p. 174.

NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) funds research and educational programs in the natural and social sciences, concentrating on diverse activities carried out at the nation's universities. Ninety-five percent of NSF's R&D funding is devoted to basic research. In recent years the Administration has made support for basic research one of the cornerstones of its R&D program, and NSF's budget has benefitted from this commitment. Its 1985 request includes $1.4 billion for R&D, a nominal increase of 14 percent (8 percent in real terms) over fiscal year 1984.

Since 1980, NSF's total R&D funding has grown 17 percent in real terms, more than any nondefense agency. As Table 12 shows, basic research funding by NSF has grown by $158 million ($84 million in 1982 dollars) since 1984, an increase of 13 (8) percent, and by $500 million ($186 million) since 1980, an increase of 60 (19) percent. Funding for applied research increased from $66 million in 1984 to $78 million in 1985, a boost of 18 (12) percent. In real terms, applied research funding by NSF in the 1985 request is only 5 percent greater than in 1980, however. A minor portion of NSF's R&D funding was allocated to development in 1980, but by 1984 development programs had been eliminated.

The following discussion describes NSF funding patterns in three areas: science, engineering, and education. Table 13 presents a general breakdown of NSF R&D funding in the various sciences and in engineering. Funding for educational activities per se are not generally categorized as R&D; in a sense, most of the R&D funds provided by NSF support education, since 76 percent of the foundation's R&D funding goes to universities.

Sciences

In 1985, NSF devotes $1.08 billion--77 percent of its total R&D budget--to research in the sciences. Total funding in this area represents an increase of 13 (7) percent over 1984 and 66 (24) percent over 1980. Within the science category, the 1985 request emphasizes the physical sciences: mathematics, computer research, chemistry, physics, cellular and molecular biology, and ocean sciences. In addition, funding for research instrumentation has increased across all disciplines.

The mathematical and physical sciences, which are broken out in Table 14, account for $417 ($364) million in 1985, an increase of 16 (10) percent over 1984. These funding levels reflect the need for research related to sophisticated computer capacity and capability, computational mathematics and statistics, and nuclear physics. In addition, the 1985 request

TABLE 12. NSF R&D FUNDING BY CATEGORY (By fiscal year, in millions of dollars of budget authority)

Category	1980 a/	1984 b/	1985 c/	1989 d/
		Current Dollars		
Basic	830	1,172	1,330	e/
Applied	55	66	78	e/
Development	8	0	0	e/
Total	893	1,238	1,408	1,619
		1982 Dollars		
Basic	975	1,077	1,161	e/
Applied	65	61	68	e/
Development	9	0	0	e/
Total	1,049	1,138	1,229	1,177
		Percentage Share		
Basic	93.0	94.7	94.5	e/
Applied	6.2	5.3	5.5	e/
Development	0.9	0	0	e/

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget and the NSF budget submission to the Congress.

a. Actual.
b. Estimated.
c. Requested.
d. Projected from Administration budget submissions.
e. Not available.

TABLE 13. NSF R&D FUNDING BY FIELD OF SCIENCE AND ENGINEERING (By fiscal year, in millions of dollars of budget authority)

Field	1980 a/	1984 b/	1985 c/
		Current Dollars	
Mathematical and Physical Sciences	225	359	417
Engineering	79	121	147
Biological, Behavioral, and Social Sciences	191	225	253
Astronomical, Atmospheric, Earth, and Ocean Sciences	215	330	363
Scientific, Technological, and International Affairs	36	36	42
Other d/	147	168	186
Total	893	1,239	1,408
		1982 Dollars	
Mathematical and Physical Sciences	264	330	364
Engineering	93	111	128
Biological, Behavioral, and Social Sciences	224	207	221
Astronomical, Atmospheric, Earth, and Ocean Sciences	253	303	317
Scientific, Technological, and International Affairs	42	33	37
Other d/	173	154	162
Total	1,049	1,138	1,229

SOURCE: The National Science Foundation budget submission to the Congress and data provided by NSF.

a. Actual.
b. Estimated.
c. Requested.
d. Includes Antarctic programs, R&D related to science and engineering education, special foreign currency, and program development and management.

TABLE 14. NSF R&D FUNDING IN THE MATHEMATICAL AND PHYSICAL SCIENCES (By fiscal year, in millions of dollars of budget authority)

Field	1980 a/	1984 b/	1985 c/
		Current Dollars	
Mathematical Sciences	25	42	51
Computer Research	18	34	39
Physics	60	106	122
Chemistry	51	80	92
Materials Research	66	98	113
Total	220	359	417
		1982 Dollars	
Mathematical Sciences	29	39	45
Computer Research	21	31	34
Physics	71	97	107
Chemistry	60	74	80
Materials Research	78	90	99
Total	260	330	364

SOURCE: The National Science Foundation budget submission to the Congress and data provided by NSF.

a. Actual.
b. Estimated.
c. Requested.

emphasizes training for future material scientists in technologically important areas, such as electronic materials, ceramics, and polymers.

Funding for the biological, behavioral, and social sciences rose from $225 million in 1984 to $253 million in 1985, an increase of 12 (7) percent.

Molecular and cellular biology account for 46 percent of the funding in this field, receiving $116 million in 1985. In the 1985 request, funding growth is strongest in physiology and cellular and molecular biology, which receive an additional $14 million compared with 1984. Research in these areas is increasingly devoted to plant science and genetic research. R&D funding for the social sciences amounts to $28 million, an increase of $3 million over 1984.

In 1985, funding for astronomical, atmospheric, earth, and ocean sciences increased 19 (5) percent over 1984, to a total $363 million. Important programs in this area include:

- o $15 million to initiate construction of the very long baseline array radiotelescope. This will be a highly sensitive instrument to improve observation of quasers and stars.

- o $5 million to begin acquisition of an Advanced Vector Computer at the National Center for Atmospheric Research. This computer will increase the capacity and capability of the present system for research in atmospheric and ocean sciences.

Engineering

Over the past five years, NSF funding for engineering R&D has outstripped even the strong growth in the agency's overall R&D budget. Engineering funding is 21 (15) percent higher in 1985 than in 1984. Since 1980, funding for NSF's engineering programs has increased by 150 (44) percent to $147 million in 1985.

Table 15 displays R&D funding for the various categories of engineering supported by NSF. Electrical, computer, and systems engineering have grown 24 (18) percent from 1984 to 1985 due to increased support in such areas as microstructure fabrication, integrated optical devices, microsensors, and robotics. Chemical and processing engineering have increased 22 (16) percent in the same period in order to fund efforts in areas such as biotechnology and catalytic reaction engineering. Mechanical engineering (for example, biomechanics and robotics) has increased 23 (18) percent from 1984 to 1985. Civil and environmental engineering had a smaller increase of 17 (13) percent, which will support coastal and ocean engineering.

The Administration's interest in engineering research is reflected in the initiation of a new $10 million program to establish centers for cross-disciplinary research in engineering. Such facility-oriented funding does not show up in Table 15. Large funding increases for research in computerized,

TABLE 15. NSF FUNDING FOR ENGINEERING R&D (By fiscal year, in millions of dollars of budget authority)

	1980 a/	1984 b/	1985 c/
		Current Dollars	
Electrical Computer and Systems Engineering	18	36	45
Chemical and Process Engineering	16	27	33
Civil and Environmental Engineering	28	34	40
Mechanical Engineering and Applied Technology	14	24	30
Total	76	121	147
		1982 Dollars	
Electrical Computer and Systems Engineering	21	33	39
Chemical and Process Engineering	19	25	29
Civil and Environmental Engineering	33	31	35
Mechanical Engineering and Applied Technology	16	22	26
Total	89	111	128

SOURCE: The National Science Foundation budget submission to the Congress and data provided by NSF.

a. Actual.

b. Estimated.

c. Requested.

integrated manufacturing systems, voice and data communication systems, and biotechnology processing systems are aimed at improving the competitiveness of U.S. industries.

Education and Other Programs

R&D for scientific, technological, and international affairs accounts for $42 million in the 1985 request, roughly 3 percent of the NSF total. Real funding for these programs has increased 11 percent compared with 1984, significant increases for small-business innovation R&D and Presidential Young Investigators awards. R&D funding in this category also includes $10 million for university-industry cooperation, the same amount as in 1984.

Although the bulk of NSF's funding is provided to colleges and universities, only $5 million of the 1985 NSF R&D budget is devoted specifically to education per se--the same level as in 1984. Other educational programs within NSF are funded at $71 million, roughly the same nominal level as in 1984. This includes $55 million for precollege mathematics and science programs, which include the $5 million devoted to educational R&D. In addition, the 1985 request includes increased R&D funding at undergraduate colleges ($42 million, up 15 percent from 1984), as well as increased support for graduate-student research awards ($103 million, up 15 percent from 1984). Finally, in a related area, the 1985 request continues the 1984 budget emphasis on improving instrumentation at the nation's academic institutions, after the Administration had cut funding for this in its earlier budgets.

Major Policy Issues

The Role of Basic Research. Increases in NSF funding (which is primarily concerned with basic research) have traditionally been justified on the grounds that such research is a necessary precondition to subsequent economic benefits. Critics of this view claim that basic research is overemphasized, noting that advances in technology occur not only because basic research has been conducted, but because firms energetically extend it and apply its results to their production processes. Japanese technological progress, for example, is due in part to Japan's emphasis on applying foreign research results. On the other hand, proponents note that the payoff period for basic scientific advance is very long and its probability of success uncertain. Private firms, therefore, may have little incentive to carry out this type of research, leaving the government with the responsibility to maintain the nation's basic research effort.

DEPARTMENT OF HEALTH AND HUMAN SERVICES

R&D funding by the Department of Health and Human Services (HHS) is dominated by the programs supported by the National Institutes of Health (NIH). These programs account for 88 percent of the nominal $4.94 billion ($4.31 billion in 1982 dollars) devoted to R&D in the HHS budget request for 1985. The Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA) accounts for most of the remainder, 7 percent of total HHS funding. The Center for Disease Control (CDC) and the Food and Drug Administration (FDA) receive 1.7 percent and 1.6 percent, respectively. Together, health programs account for 99 percent of the HHS total for R&D.

Table 16 describes the overall breakdown of HHS R&D funding. HHS is the major federal sponsor of civilian basic research, almost all of which flows through NIH and ADAMHA. This is shown in Table 17, which details the R&D budget of the four major health agencies that together account for 98 percent of HHS R&D. Under the current Administration, basic research has increased its share of total HHS R&D funding, while funding for both applied research and development has declined significantly in real terms (by 21 and 44 percent, respectively, since 1980). The same shift toward basic research is evident in the budgets of NIH and ADAMHA. Renewed emphasis on basic research also provides an explanation for the decline in real R&D funding at CDC and FDA (28 and 19 percent, respectively, since 1980) since R&D funding by these agencies is completely devoted to applied research.

National Institutes of Health

As these tables show, any assessment of HHS R&D must concentrate on health programs, particularly those at NIH. The Administration has emphasized disease prevention and health maintenance in its health R&D efforts, in addition to the curative focus that has traditionally characterized NIH activities. The Administration has generally sought to reduce real NIH funding, but the Congress has maintained the Institutes' R&D funding at a roughly constant real level. In 1982 dollars, NIH R&D is funded at $3.79 billion in the 1985 request, up from $3.75 in 1980.

Other aspects of NIH activities have been more controversial than the funding aggregates. Proposals have been made to reorganize NIH, establishing new institutes. For example, last fall, the House approved a separate National Institute of Arthritis and a National Institute on Nursing. Proposals to increase legislative control of NIH programs have also been discussed by the Congress. For its part, the Administration has sought to reduce government outlays for the indirect costs (overhead) of NIH-funded

TABLE 16. HHS R&D FUNDING BY CATEGORY (By fiscal year, in billions of dollars of budget authority and in percents)

Category	1980 a/	1984 b/	1985 c/	1989 d/
		Current Dollars		
Basic	1.76	2.78	2.91	e/
Applied	1.56	1.71	1.68	e/
Development	0.46	0.36	0.35	e/
Total	3.78	4.84	4.94	5.32
		1982 Dollars		
Basic	2.07	2.56	2.54	e/
Applied	1.84	1.57	1.46	e/
Development	0.54	0.33	0.30	e/
Total	4.44	4.45	4.31	3.87
		Percentage Share		
Basic	47	57	59	e/
Applied	41	35	34	e/
Development	12	7	7	e/

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget and the Department of Health and Human Services budget submission to the Congress.

a. Actual.
b. Estimated.
c. Requested.
d. Projected from Administration budget submissions.
e. Not available.

TABLE 17. R&D FUNDING BY THE MAJOR R&D SPONSORS WITHIN HHS
(By fiscal years, in millions of dollars of budget authority)

R&D Sponsor	1980 a/ Current Dollars	1980 a/ 1982 Dollars	1984 b/ Current Dollars	1984 b/ 1982 Dollars	1985 c/ Current Dollars	1985 c/ 1982 Dollars
NIH d/						
Basic	1,644	1,932	2,608	2,395	2,738	2,391
Applied	1,149	1,350	1,283	1,178	1,261	1,101
Development	396	465	346	318	342	299
Total	3,188	3,747	4,236	3,891	4,342	3,791
ADAMHA e/						
Basic	100	118	155	142	159	139
Applied	136	160	189	174	194	169
Development	0	0	2	2	2	2
Total	235	276	346	318	355	310
CDC f/						
Basic	0	0	0	0	0	0
Applied	87	102	84	77	84	73
Development	0	0	0	0	0	0
Total	87	102	84	77	84	73
FDA g/						
Basic	0	0	0	0	0	0
Applied	75	88	79	73	81	71
Development	0	0	0	0	0	0
Total	75	88	79	73	81	71

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget.

a. Actual.
b. Estimated.
c. Requested.
d. National Institutes of Health.
e. Alcohol, Drug Abuse, and Mental Health Administration.
f. Center for Disease Control.
g. Food and Drug Administration.

extramural research, although this initiative is not included in the 1985 request. Finally, the number of extramural NIH research grants (funding for activities performed outside NIH at universities, independent laboratories, and so on) has also been questioned. In the late 1970s, the Carter Administration committed itself to an annual goal of 5,000 new and competing NIH grants. Despite the Reagan Administration's interest in setting lower goals, the Congress and the scientific community have kept new and competing grants at or near the 5,000 level--although at the expense of other NIH programs.

The 1985 request reflects some increase in the Administration's support for extramural R&D funded by NIH. Funds are requested to maintain the level of 5,000 new and competing NIH grants. The funding provided by NIH to scientists and universities is up 3 percent from 1984 in nominal terms, representing a real decrease of 2 percent. The 1985 level of NIH support for colleges and universities still exceeds the 1980 level in real terms, however, after real NIH funding for university R&D was cut sharply in the Administration's first budgets.

Table 18 details funding levels for the various National Institutes of Health. In each case, nominal funding in 1985 exceeds the 1984 level, while 1984 funding is greater than the 1985 budget level in 1982 dollars. Among the nonadministrative branches of NIH, the rates of growth in nominal funding from 1984 to 1985 are remarkably constant, ranging from a low of 1.2 percent to a high of 3.6.

When real 1985 funding is compared with the 1980 spending pattern, however, the results are not so uniform. Real funding is down 16 percent at the largest of the NIH branches, the National Cancer Institute (NCI)--representing a reduction of $182 million in 1982 dollars. This reflects in part the transfer of the National Toxicology Program to another health institute. Moreover, it should be noted that the decrease in NCI funding followed a 450 percent nominal increase in NCI funding from 1970 to 1980. Every other institute has experienced real growth. In several cases, the growth has been substantial. In 1982 dollars, funding for R&D in allergies and infectious diseases is up from $241 million in 1980 to $276 in 1985--a real increase of 16 percent. Much of this increase reflects increased funding for research into Acquired Immune Deficiency Syndrome (AIDS), work-related infectious diseases, and herpes. R&D funded through the National Institute of Environmental Health Sciences (NIEHS) shows a 72 percent real increase from 1980 to 1985--largely because of the transfer of the National Toxicology Program from NCI to NIEHS. Finally, the Institute on Aging, which is a relatively small source of funding, has experienced 27 percent real growth since 1980, increasing its efforts in such areas as Alzheimer's disease.

TABLE 18. R&D FUNDING BY THE NATIONAL INSTITUTES OF HEALTH, FISCAL YEARS 1984 AND 1985 (In millions of dollars of budget authority)

Institutes	1984 a/		1985 b/	
	Current Dollars	1982 Dollars	Current Dollars	1982 Dollars
Cancer	1,052	966	1,077	940
Heart, Lung, and Blood	673	618	689	602
Dental	84	77	87	76
Arthritis, Diabetes, Digestive, and Kidney Diseases	443	407	455	397
Neurological and Communicative Disorders and Stroke	325	299	334	292
Allergy and Infectious Diseases	305	280	316	276
General Medical Sciences	365	335	374	327
Child Health and Human Development	264	242	270	236
Eye	151	139	154	134
Environmental Health Sciences	173	159	178	155
Aging	112	103	114	100
Research Resources	242	222	245	214
Other c/	50	46	51	45
Total	4,236	3,891	4,342	3,791

SOURCE: Congressional Budget Office from National Institutes of Health budget submission to the Congress.

a. Estimated.
b. Requested.
c. Fogarty International Center, National Library of Medicine, and the Office of the Director.

ADAMHA Programs

The Alcohol, Drug Abuse, and Mental Health Administration is the second-largest source of R&D funding in HHS. Although its R&D budget request for 1985, at $355 million, is up only 3 percent in nominal terms and down 2 percent in real terms from the 1984 level, ADAMHA R&D programs have experienced 12 percent real growth since 1980 (see Table 17). ADAMHA is a major source of funding for behavioral and social science research, and these programs were cut significantly in the first budgets submitted by the Administration. The ADAMHA R&D budget began to receive more favorable treatment in the 1984 budget, reflecting rising concern over alcohol and drug abuse, particularly among young people.

Mental health programs account for about 62 percent of ADAMHA R&D, down from 68 percent in 1983. Alcoholism accounts for roughly 16 percent, up from 13 in 1983, while drug programs have increased their share from about 19 to about 22 percent over that time period. Roughly 60 to 65 percent of ADAMHA R&D is extramural.

Major Policy Issues

NIH Authorization. The NIH accounts for 88 percent of the 1985 R&D funding request for HHS, or $4.3 billion. Only two of NIH's 11 institutes--the National Cancer Institute and the National Heart, Lung, and Blood Institute, accounting for $1.7 billion of the 1985 request--are subject to the Congressional authorization process. The balance of NIH operates under the permanent general authority of the Public Health Service Act of 1944. In recent years, however, the Congress has debated whether to bring all of NIH into the annual authorization process. Proponents of periodic authorization note that other federal health programs undergo oversight and reauthorization every three years, and that oversight and reauthorization of a program as large as NIH is warranted. They point out that NIH's statutory authority was last revised in 1944 and might require technical redrafting. Supporters of the existing system, however, believe that the periodic reauthorization would disrupt the continuity of NIH's work and leave it vulnerable to frequent changes in direction.

A related issue is whether or not those NIH institutes that are currently funded uncategorically--all but the Cancer and Heart, Lung, and Blood Institutes--should receive separate appropriations. The underlying issue is the degree of control that the Congress should exercise over specialized scientific programs. Proponents of uncategorical appropriations see the NIH as being responsive to evolving national health needs--pointing to, for example, recent increases in funding for research into emerging

health problems such as AIDS and Alzheimer's disease. They feel that decisions regarding the disposition of health research funds should be left to the medical community. On the other hand, supporters of categorical appropriations see shifts in NIH funding as resulting, in part, from the priorities endorsed by the Congress, and believe that the medical community is, itself, a "special interest" that might allocate funds on a basis other than scientific merit.

R&D's Role in the National Health System. The national health system in the United States is beset by a variety problems, including increases in health-care costs far greater than underlying rates of inflation, the aging of the population, and the funding of the Medicare and Medicaid systems. Health-care R&D is also becoming more expensive. Some analysts believe that health R&D could ameliorate some of these problems, particularly the spiraling of health costs, by emphasizing preventive medicine and by devising lower cost methods (less expensive equipment, for instance) for delivering health services. The Administration's 1985 proposal does increase funding for preventive medicine and health maintenance efforts.

It should be noted, however, that the potential contribution of health R&D to slowing health cost inflation could be limited. Successful R&D might result in greater longevity and new curative techniques that actually increase health-care costs by increasing the quality of service provided by the health system and the number of patients it serves. As a result, it may be unrealistic to expect health R&D to resolve the difficult problems facing the nation's health-care system. Health cost inflation could be addressed by changing the structure of the health-care delivery system. 11/ Research into the impact of alternative health policies on the costs of health care might contribute significantly to cost containment. NIH may not be the most appropriate sponsor of such research, however.

DEPARTMENT OF AGRICULTURE

The Department of Agriculture has a long history of supporting R&D, and some observers believe its programs are a model of federal support for industrial innovation. The Department of Agriculture's R&D programs are directed toward the various technical problems that confront the nation's farmers: more productive crop varieties, pest control, fertilizing practices,

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11. See Congressional Budget Office, Containing Medical Care Costs Through Market Forces (May 1982); and Controlling Rising Hospital Costs (September 1979).

crop harvesting and storage techniques, and so on. In addition, the department has longstanding relationships with the nation's universities and an extensive network for diffusing technological innovations throughout the farming sector. Unlike most of the government's R&D effort, which took shape after World War II, the Department of Agriculture's technological effort has roots that extend to the 19th century.

The Department of Agriculture has traditionally concentrated on applied research. As Table 19 shows, the Administration has shifted the department's focus toward basic research, the same trend that is evident in other civilian agencies. Yet real funding for applied research has not been cut drastically, and development funding has never accounted for a major share of Agriculture's R&D budget. As a result, the department's overall R&D budget--which amounts to almost $900 million in nominal dollars ($780 million in 1982 dollars) in 1985, up from $869 million ($799 million) in 1984--has experienced nominal growth since 1980, a period in which most other civilian agencies have reduced nominal R&D funding. The reasons for this difference probably include the perceived success of Agriculture's R&D programs, their long history, the importance of agriculture to the U.S. balance of payments, and the perception that the agricultural sector comprises many small production units that are unable to support their own R&D programs (although the growing concentration of U.S. agriculture suggests that this last point is increasingly doubtful). 12/ In addition, the potential of new technologies, such as genetic engineering, provides a strong argument that federal support of agricultural R&D may generate significant economic benefits. Agribusiness firms, recognizing this potential, have also been increasing their R&D spending.

In real terms, Department of Agriculture R&D funding in the 1985 budget is 2 percent below the 1984 level and 4 percent below the 1980 level. Basic research funding, however, is up in real terms (3 percent above 1984 and 12 percent above 1980). Applied research funding is down slightly from 1984; in real terms, funding for such programs has been decreased by 6 percent since 1984 and 14 percent since 1980. Nominal development funding, which accounts for a small part of the Department of Agriculture's R&D budget, has dropped slightly since 1980, but in real terms is down 10 percent since 1984 and 30 percent since 1980.

The Department of Agriculture's R&D funding flows through many of the bureaus that make up the department. The major sources of R&D funding are the Agricultural Research Service (ARS), the Cooperative State

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12. See Congressional Budget Office, Crop Price Support Programs: Policy Options for Contemporary Agriculture (February 1984).

TABLE 19. DEPARTMENT OF AGRICULTURE R&D FUNDING BY CATEGORY (By fiscal year, in millions of dollars of budget authority and in percents)

Category	1980 a/	1984 b/	1985 c/	1989 d/
		Current Dollars		
Basic	280	386	420	e/
Applied	387	453	450	e/
Development	31	30	29	e/
Total	697	869	898	879
		1982 Dollars		
Basic	329	355	367	e/
Applied	455	416	393	e/
Development	36	28	25	e/
Total	819	799	784	639
		Percentage Share		
Basic	40.2	44.4	46.8	e/
Applied	55.5	52.1	50.1	e/
Development	4.5	3.5	3.2	e/

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget and the Department of Agriculture budget submission to the Congress.

a. Actual.
b. Estimated.
c. Requested.
d. Projected from Administration budget submissions.
e. Not available.

Research Service (CSRS), the Forest Service, and the Economic Research Service (ERS). Together, these four agencies account for over 97 percent of total 1985 R&D funding by the Department of Agriculture. ARS accounts for 52 percent of the total; CSRS, 29 percent; the Forest Service, 11 percent; and ERS, 5 percent. Table 20 describes the pattern of R&D funding by these agencies. Other branches of the Department of Agriculture that fund R&D include the Statistical Reporting Service ($8.5 million in 1985), which provides information needed for forecasting, the Human Nutrition Information Service ($7.5 million), and the Office of International Cooperation and Development ($5.4 million).

Agricultural Research Service

R&D funding by the Agricultural Research Service has increased 3 percent over the 1984 level--representing a real decrease of 2 percent. Since 1980, R&D funding by this agency has decreased by about 4 percent in real terms. The ARS is the principal in-house agricultural research agency of the Department of Agriculture and maintains agricultural research stations throughout the United States. The ARS is also the major sponsor of basic research in the Department of Agriculture. Basic research funding has increased its share of the ARS R&D total from 45 percent in 1980 to 51 percent in 1985; in real terms ARS basic research funding is down 2 percent from 1984 but is 10 percent higher than the 1980 level. Real funding for ARS applied research is down by 2 percent since 1984 and 14 percent since 1980. For development programs, the real decreases amount to 4 percent and 20 percent, respectively. About 65 percent of the total $7.6 million increase in 1985 ARS R&D over 1984 is devoted to salary adjustments for R&D personnel.

ARS research programs support a wide range of agricultural activities: plant production; animal production; agricultural resource conservation and improvement; and processing, storage, and distribution of crops. In addition, ARS carries out R&D concerning human nutrition. Plant production programs account for about 40 percent of the ARS R&D budget and comprise the development and improvement of crops as well as improved production practices. Minor increases in funding are included for genetic engineering, interdisciplinary techniques relating to improved farm management, and pest control.

Animal production programs account for about 18 percent of ARS R&D funding. These programs had the smallest increase in 1985 among broad ARS categories--3 percent. Changes in animal production R&D funding, excluding salary adjustments, involve minor increases in genetic

TABLE 20. R&D FUNDING BY MAJOR R&D SPONSORS WITHIN THE DEPARTMENT OF AGRICULTURE (By fiscal year, in millions of dollars of budget authority)

R&D Sponsor	1980 a/ Current Dollars	1980 a/ 1982 Dollars	1984 b/ Current Dollars	1984 b/ 1982 Dollars	1985 c/ Current Dollars	1985 c/ 1982 Dollars
ARS d/						
Basic	161.4	189.7	232.5	213.6	240.1	209.6
Applied	174.7	205.3	194.9	179.0	201.2	175.7
Development	23.8	28.0	25.5	23.4	25.6	22.4
Total	360.0	423.1	452.9	416.0	466.9	407.7
CSRS e/						
Basic	75.8	89.1	101.5	93.2	128.6	112.3
Applied	110.2	129.5	136.2	125.1	128.2	111.9
Development	0.0	0.0	0.0	0.0	0.0	0.0
Total	186.0	218.6	237.7	218.3	256.8	224.2
Forest Service						
Basic	33.7	39.6	41.3	37.9	40.2	35.1
Applied	72.3	85.0	64.1	58.9	59.8	52.2
Development	5.5	6.5	3.3	3.0	3.0	2.6
Total	111.5	131.0	108.7	99.8	103.0	89.9
ERS f/						
Basic	g/	g/	4.4	4.0	4.7	4.1
Applied	g/	g/	39.9	36.6	42.8	37.4
Development	g/	g/	0.0	0.0	0.0	0.0
Total	35.4	41.6	44.3	40.7	47.5	41.5

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget.

a. Actual.
b. Estimated.
c. Requested.
d. Agricultural Research Service.
e. Cooperative State Research Service.
f. Economic Research Service.
g. Not available.

engineering and veterinary programs. In other areas, minor funding increases have been provided for soil improvement and erosion control and for improved storage techniques.

Cooperative State Research Service

The Cooperative State Research Service is the principal extramural research agency within the Department of Agriculture. It distributes funds to universities and similar organizations that carry out agricultural R&D. Like ARS, it funds a very diverse range of programs. CSRS R&D funding has increased 8 (3) percent since 1984 and 38 (3) percent since 1980, reflecting the agency's increased emphasis on basic research funding, which has risen 70 (26) percent since 1980. Most of the increase in basic research occurs in the 1985 budget, which boosts such programs by $27 million ($19 million) over 1984--an increase of 27 (20) percent. By contrast, applied research funding has been reduced 6 (11) percent since 1984 and has fallen 12 percent in real terms since 1980. Applied research, which accounted for almost 60 percent of the CSRS R&D budget in 1980, now makes up slightly less than half of that agency's total. CSRS funds no development projects.

The major focus of CSRS R&D is biotechnology and genetic engineering, which investigate the cellular and molecular foundations of agricultural phenomena. This R&D accounts for over 80 percent of the CSRS R&D budget. The major new initiative in this area is the institution of competitive research grants in genetic engineering, funded at $28.5 million. Other biotechnology funding has been increased by $3 million in the 1985 budget, to a total of $152 million. Competitive grants amounting to $4.5 million have also been established for animal science research. CSRS funding has been decreased for programs in such areas as forestry research, down to $12.7 million from $13 million in 1984; alcohol fuels and native latex, down to $15.5 million from $26.5 million in 1984; and animal health and disease, $5.8 million in 1984 but eliminated in 1985. Finally the 1985 CSRS R&D budget includes special funding for grants to traditionally black colleges, a goal that is also evident in the ARS budget.

Forest Service

The Administration has substantially reduced R&D funding by the Forest Service in 1985. Forest Service R&D amounts to $103 million in 1985, down 5 (10) percent from 1984 and 8 (31) percent from 1980. Forest Service funding has fallen for all three categories of R&D, although basic research funding has been relatively favored. The Administration justifies

these trends on the grounds that private-sector incentives exist for such research and that scientific understanding already is adequate to preserve and maintain the nation's timber resources. The reductions in the 1985 budget are spread across the agency's R&D programs and entail the closure of some small laboratories.

Economic Research Service

The Economic Research Service is the last major sponsor of R&D within the Department of Agriculture. Since 1980, ERS R&D funding, about 90 percent of which is for applied research, has held roughly constant in real terms. ERS funds analyses of the agricultural economy that are carried out at universities as well as by its in-house staff. In addition, it provides services to other government agencies. ERS R&D involves developing economic models of the agricultural sector, forecasting price and quantity trends, costing government programs, monitoring international trends, and so on. The 1985 request provides increased funding for R&D related to the interactions between the agricultural sector and the macroeconomy.

Major Policy Issues

Privatizing Agricultural Research. Some elements of the Department of Agriculture's research program involve research in the distribution and marketing of agricultural products and other economic or operational aspects of farm management. Given the growing concentration of U.S. agriculture, some of the burden of this research could be carried out by the private agricultural sector. Private agricultural firms have been increasing their R&D spending in recent years. Moreover, to the extent that they reduce unit production costs, the government's agricultural R&D programs primarily benefit large farms, since their benefits for private producers are proportional to the farm's production volume. On the other hand, public R&D for farm management may assist smaller farms as well, since it provides them with information that larger-scale farmers may have produced or developed on their own.

Biotechnology and Genetic Engineering. The CSRS has initiated a new program extending competitive research grants in genetic engineering. Some analysts have claimed that research in this area has lagged. Moreover, the results of this research might be particularly helpful in promoting farm products that conserve water and chemical fertilizers in their production and are more resistant to disease and pests, thus reducing the need for potentially hazardous pesticides. On the other hand, proposed funding for biotechnology greatly exceeds the level of funds allocated to other promising civilian technologies.

DEPARTMENT OF THE INTERIOR

The Department of the Interior funds R&D in several areas, particularly in cataloging and developing the nation's mineral resources and in protecting the nation's wildlife. Table 21, which describes Interior's overall R&D budget, shows that the department, like most other civilian R&D agencies, has significantly reduced its R&D funding in the past five years, in both real and nominal terms. R&D funding in the 1985 request, at $364 million ($318 million in 1982 dollars), is down 6 (11) percent from the 1984 level of $388 million ($357 million).

The 1985 request calls for an 8 (12) percent decrease in Interior basic research from the 1984 level. Compared with 1980, basic research funding in 1982 dollars is the same in 1985--$85 million. Compared with 1984, applied research has been reduced 5 (9) percent and development 8 (13) percent. Since 1980, funding for these programs has fallen 11 (34) percent and 62 (72) percent, respectively.

Interior's R&D funding is funnelled through the various agencies that make up the department. The most important of these are the Geological Survey, which accounts for 41 percent of Interior's total R&D in 1985; the U.S. Fish and Wildlife Service, which accounts for 31 percent; and the Bureau of Mines, which receives 19 percent. Together, these agencies account for over 90 percent of the department's 1985 R&D budget. The remaining 10 percent--$35.2 million in 1985--flows through Interior's other agencies, especially the National Park Service, which accounts for $13.7 million, and the Bureau of Reclamation, $11.5 million.

Geological Survey

The 1985 R&D budget of the Geological Survey is $148.1 million, about the same nominal level as in 1980 but a real decrease of 27 percent. The 1985 request is 8 (13) percent below the 1984 level of $161 million ($141 million in 1982 dollars). While basic research funded by the Geological Survey has risen from $48 million to $58 million since 1980, it has fallen 10 percent in real terms. Compared with 1984, the agency's basic research budget has decreased 5 (10) percent and now makes up 39 percent of R&D funded by the Geological Survey, up from 32 percent in 1980. By contrast, funding for applied research is reduced to $86.8 million in 1985 from $96.6 million in 1984--a real decrease of 15 percent--and from $102 million in 1980--a real decrease of 37 percent. Development funding, which accounts for only 2.5 percent of the Geological Survey's 1985 R&D budget, has increased by about $3 million since 1980.

TABLE 21. DEPARTMENT OF THE INTERIOR R&D FUNDING BY CATEGORY (By fiscal year, in millions of dollars of budget authority and in percents)

Category	1980 a/	1984 b/	1985 c/	1989 d/
		Current Dollars		
Basic	72	106	97	e/
Applied	280	260	248	e/
Development	52	21	20	e/
Total	404	388	364	393
		1982 Dollars		
Basic	85	97	85	e/
Applied	329	239	217	e/
Development	61	20	17	e/
Total	475	357	318	286
		Percentage Share		
Basic	17.8	27.4	26.6	e/
Applied	0.3	67.1	68.1	e/
Development	12.9	5.5	5.5	e/

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget and the Department of the Interior budget submission to the Congress.

a. Actual.
b. Estimated.
c. Requested.
d. Projected from Administration budget submissions.
e. Not available.

The Geological Survey's R&D programs are directed toward improving knowledge of the nation's mineral resources and increasing scientific understanding of geological processes. The 1985 budget contains increased funding for digital cartography programs, which apply advanced computer techniques to one of the agency's traditional missions. Programs related to the effects of hazardous-waste storage on underground water resources are also being emphasized. Overall water programs are reduced, however, including the elimination of federal support for state Water Resources Research Institutes (providing a savings of $6.4 million). Funding is also reduced for earthquake and volcano hazard studies.

Fish and Wildlife Service

The 1985 R&D budget of the U.S. Fish and Wildlife Service amounts to $112.1 million ($98 million in 1982 dollars), up from $106.4 million ($98 million) in 1984 and $87.3 million ($103 million) in 1980. In real terms, therefore, this agency's R&D budget is 5 percent below the 1980 level. R&D funding for the service has not been reduced to the same extent as the R&D supported by other agencies in the Department of Interior. Applied research dominates R&D funding by the Fish and Wildlife Services, accounting for 86 percent of the total in 1985, up from 80 percent in 1980. A decline in the development share accounts for this trend. Basic research funding, which represents a small share of the total Fish and Wildlife Service R&D budget, amounts to $6.4 million in 1985, down from $7.4 million in 1984. Since 1980, however, basic research funding by the Fish and Wildlife Service has increased 73 (29) percent.

The Fish and Wildlife Service funds R&D related to monitoring the population, habitat, and behavior of the nation's fish and wildlife. It pays particular attention to endangered species, with new funding in 1985 for mussel and manatee research. The 1985 budget also reflects increased emphasis on the environmental impact of chemical contaminants and acid rain on fish and wildlife. These programs contribute to the government's overall R&D effort concerning acid rain and hazardous waste (including toxic substances and pesticides). The 1985 request also reduces funding for the cooperative research units that work with states and universities on regional habitat studies. The Administration has sought to eliminate this program in the past, but the Congress has preserved it.

Bureau of Mines

The 1985 R&D request for the Bureau of Mines has been cut substantially, from $106 million in 1980 and $87 million in 1984 to $69 million in 1985. This represents a real decrease of 25 percent from 1984 and

52 percent from 1980. While the 1985 request represents a substantial reduction from the 1984 funding level, this does not reflect a shift in Administration policy, since its 1984 request for Bureau of Mines R&D was only $68 million. The Administration's effort to reduce overall R&D funding by the Bureau of Mines has entailed a significant reorientation in the bureau's R&D activities toward basic research and away from applied research and development. The bureau's basic research budget amounts to $32.3 million in the 1985 request, down from $36.7 million in 1984 but up from $11.3 million in 1980--a real increase of 112 percent since 1980. Applied research, by contrast, has been reduced from $66 million in 1980 and $47 million in 1984 to $34 million in 1985--representing a real decrease of over 60 percent since 1980. Development funding has been cut even more drastically, from $28 million in 1980 to $4 million in 1984 and $2.3 million in 1985.

The pattern of R&D funding at the Bureau of Mines reflects an effort to rely on the private sector to support applied research and development for the mining industry. Programs in minerals and materials research are being maintained at a constant nominal level. These programs support fundamental R&D in extractive and processing technologies. Funding for conservation R&D has been reduced from $14.8 million in 1984 to $5.9 million in 1985. Most of this reduction results from the phaseout of the bureau's Mine Equipment Test Facility. Finally, R&D in mine health and safety technology has been reduced from $37.6 million in 1984 to $32.1 million in 1985.

Major Policy Issues

Reduced Funding for the Bureau of Mines. As in past budgets, the Administration has proposed lower R&D funding by the Bureau of Mines in 1985. Many of the Bureau's programs represent commercially oriented activities for which adequate private-sector incentives may exist. On the other hand, given increased competition from foreign mineral producers, this R&D effort might serve to promote employment in depressed metals industries and reduce U.S. dependence on foreign minerals. 13/

ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency (EPA) funds a significant amount of R&D in support of its mission to monitor and regulate the nation's

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13. See Congressional Budget Office, Strategic and Critical Nonfuel Minerals: Problems and Policy Alternatives (August 1983).

environment. R&D funding by the EPA, like that agency's overall budget, has been highly volatile in recent years. This is shown in Table 22, although the figures presented there actually understate the recent unevenness in the agency's R&D funding, which was particularly evident in the 1981-1983 budgets. The reductions in EPA R&D funding during the early 1980s naturally disrupted the agency's R&D effort.

Besides the cuts themselves, the pattern of reduction was significant. The EPA reduced its external programs, limiting the support it provided to universities and similar institutions that carry out R&D concerning the underlying nature of pollution, its sources, and its effects. Instead, budgets emphasized EPA's in-house R&D, which relates basic scientific research to the agency's statutory responsibility to establish pollution standards. Real funding for such scientific assessment programs has increased 60 percent since 1980. In conjunction with the deemphasis of extramural programs, EPA's R&D effort also shifted toward more short-term, compliance-oriented projects and away from long-term research of a more fundamental nature. EPA justified its emphasis by noting that the agency's pressing regulatory agendas contained a lengthy schedule of standards to be promulgated in the short term.

Table 22 shows that, compared with 1984, the 1985 EPA budget request includes increases in every category of R&D: a nominal 11 percent (5 percent in real terms) in basic research, 13 (7) percent in applied research, and 13 (8) percent in development. Total R&D funding in the 1985 EPA request amounts to $280 million ($244 million in 1982 dollars), 13 (7) percent above the 1984 level. Nevertheless, total EPA R&D funding in the 1985 request is 18 (39) percent below the 1980 level, and only basic research shows an increase from 1980--92 (47) percent. In 1985, slightly over 60 percent of EPA's R&D funding will go for extramural activities, the same share as in 1984 and up slightly from the 1983 level.

The volatility in the EPA budget makes it somewhat difficult to assess trends in that agency's R&D programs. Table 23 breaks down EPA R&D funding by activity. The data presented there reflect EPA's shift in emphasis from air and water pollution to the problems associated with hazardous waste. Hazardous-waste R&D programs emphasize the collection and interpretation of data needed to evaluate waste-site designations and alternative treatment technologies. Such programs, including Superfund R&D aimed at developing techniques for cleaning up abandoned waste sites, have risen from $13 million ($15 million) in 1980 and $41 million ($38 million) in 1984 to $48 million ($42 million) in the 1985 request. These trends represent a 1985 increase of 17 (11) percent over the 1984 level and 270 (180) percent over 1980. In the 1985 request, R&D funding accounts for

TABLE 22. EPA R&D FUNDING BY CATEGORY (By fiscal year, in millions of dollars of budget authority and in percents)

Category	1980 a/	1984 b/	1985 c/	1989 d/
		Current Dollars		
Basic	13	23	25	e/
Applied	229	154	173	e/
Development	99	71	81	e/
Total	342	248	280	280
		1982 Dollars		
Basic	15	21	22	e/
Applied	269	142	151	e/
Development	116	65	71	e/
Total	402	228	244	204
		Percentage Share		
Basic	3.9	9.2	9.1	e/
Applied	67.2	62.0	62.0	e/
Development	28.9	28.8	29.0	e/

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget and the Environmental Protection Agency budget submission to the Congress.

a. Actual.
b. Estimated.
c. Requested.
d. Projected from Administration budget submissions.
e. Not available.

TABLE 23. EPA R&D FUNDING BY ACTIVITY (By fiscal year, in millions of dollars of budget authority)

Activity	1980 a/	1984 b/	1985 c/
		Current Dollars	
Air Quality	68	62	65
Water Quality	67	25	27
Hazardous Waste	13	32	35
Superfund	---	9	13
Toxic Substances	31	24	27
Pesticides	13	6	8
Energy/Acid Rain	103	30	49
Drinking Water	23	24	23
Interdisciplinary	8	21	20
Radiation	3	2	2
Management	4	9	9
Total d/	342	248	280
		1982 Dollars	
Air Quality	80	57	57
Water Quality	79	23	24
Hazardous Waste	15	29	31
Superfund	---	8	11
Toxic Substances	36	22	24
Pesticides	15	6	7
Energy/Acid Rain	121	28	43
Drinking Water	27	22	20
Interdisciplinary	9	19	17
Radiation	4	2	2
Management	5	8	8
Total d/	402	228	204

SOURCE: Congressional Budget Office from the Environmental Protection Agency budget submission to the Congress and NSF data.

a. Actual.
b. Estimated.
c. Requested.
d. Includes programs funded under the abatement, control, and compliance appropriations that are not broken out in the table.

roughly one-quarter of total hazardous-waste programs and about 2 percent of the total Superfund program. In addition, hazardous-waste problems receive increased attention in the R&D programs of other EPA offices, such as air and water quality, and of other government agencies, such as the Department of Interior.

Funding for the related problems of toxic substances and pesticides has also been increased. Toxic-substance R&D programs are up 11 percent from the 1984 level, although funding for these programs is still 13 (33) percent below the 1980 level. Toxic-substance R&D is devoted primarily to evaluating the health hazards associated with new and existing chemicals, especially organic compounds such as polychlorinated biphenyl (PCB), and to developing related measurement and monitoring technologies. Pesticides R&D exhibits a similar funding pattern, with the 1985 request above the 1984 level but down 38 (54) percent from 1980. If toxic-substance and pesticide R&D are aggregated with hazardous-waste R&D, real funding for these activities has increased only 10 percent since 1980.

EPA funding for R&D related to acid rain, which is included among EPA's energy R&D programs, has also been increased. Between 1980 and 1984, the energy programs were cut by 71 (77) percent. The resurgence of energy R&D in the 1985 request stems from increased acid-rain R&D, which is funded at $34 million, up from $15 million in 1984. In addition, the 1985 request includes a $5.5 million supplemental appropriation for acid-rain R&D for fiscal year 1984. Besides research into the chemistry of the acid-rain phenomenon, increased R&D for acid rain will be devoted to completing a nationwide survey of lake chemistry and to initiating a similar forest survey.

Compared with 1984, the 1985 request provides $3 million in increased funding for air-quality R&D, to a total of $65 million ($57 million,) and a $2 million increase for water-quality R&D, to a total of $27 million ($24 million). Compared with 1980, the 1985 request for air-quality R&D represents a 4 (29) percent reduction; the difference is even starker for water-quality programs, down 60 (70) percent. These programs (which, together with energy, dominated the EPA R&D budget in the Carter Administration) provide the strongest evidence of the EPA's reorientation toward R&D related to achieving compliance standards. EPA justifies this trend on the grounds that the R&D needed to establish standards for air and water pollution is largely completed. Most of the funding cuts in air-quality R&D has fallen on longer-term projects. Reductions have been particularly severe in wastewater treatment programs--although these cuts occurred in previous budgets. The 1985 water request includes $2.5 million (the same as in 1983 and 1984) for Great Lakes Research, a joint U.S./Canadian program that the Administration had sought to eliminate in previous years.

The only activity categories in which the 1985 request calls for reduced funding compared with 1984 are drinking-water programs and interdisciplinary R&D, which involves work common to several pollution categories. According to the EPA, the reduction for drinking-water R&D reflects the completion of efforts to assess the impact of the pesticide Temik and cooperative research projects with the water utility industry. Interdisciplinary R&D programs involve longer-term projects. The reported decrease in such programs is illusory, since it stems from the transfer of $1.8 million (devoted to economic benefits research) to another office within EPA.

Table 24 presents an alternative breakdown of EPA R&D programs, based on program definitions rather than on activities. It shows both real and nominal increases in most areas of funding compared to 1984. Funding increases for scientific assessment programs, which make up less than

TABLE 24. EPA R&D FUNDING BY PROGRAM DEFINITION, FISCAL YEARS 1984 AND 1985 (In millions of dollars of budget authority)

Program Definition	1984 a/ Current Dollars	1984 a/ 1982 Dollars	1985 b/ Current Dollars	1985 b/ 1982 Dollars
Scientific Assessment	10.9	10.0	11.9	10.4
Monitoring and Quality Assessment	36.1	33.2	41.0	35.8
Health Effects	49.7	45.6	53.5	46.7
Environmental Engineering and Technology	53.1	48.8	58.5	51.1
Environmental Proceeds and Effects	46.9	43.1	46.5	40.6
Other c/	44.5	40.9	57.4	50.1

SOURCE: Congressional Budget Office based on data provided in the EPA budget submission to the Congress.

a. Estimated.
b. Requested.
c. Includes acid rain, most interdisciplinary programs, Great Lakes Study, National Toxicology Center, and so on. Totals do not correspond to those in Tables 22 and 23 because of the nonclassification of program management funding.

5 percent of the EPA R&D budget, have characterized EPA budgets since 1980. Health-effects R&D--which provides a basis for setting future standards--is up 8 (2) percent from 1984 but is down more than 40 percent in real terms from the 1980 level. R&D in environmental process and effects is the only major program category that is currently being reduced, down 1 (6) percent since 1984.

Major Policy Issues

The Mix of Programs. EPA's 1985 budget request for R&D continues the trend established in 1984 of restoring funding for extramural activities (work sent outside the agency to contractors and independent laboratories). In the Administration's first budget submission, extramural R&D was cut significantly, and it has still not returned to the 1980 level. The balance between in-house and extramural R&D is important because most of the agency's exploratory research on environmental processes and effects is supported through extramural funding. Such research contributes to a more basic understanding of environmental processes and hazards. While it typically is not used to establish upcoming standards, it provides a scientific base for developing future standards and revisions. Despite the upward trend in EPA extramural R&D funding, some observers have questioned whether the agency's capability to revise standards and understand future problems will be adequate. On the other hand, the agency's internal R&D activities have been focused on scientific assessment, which supports near-term standards development. In the agency's view, its emphasis on assessing existing studies of pollution and its health effects will be more productive than increasing the number of long-term studies.

DEPARTMENT OF TRANSPORTATION

The Department of Transportation (DOT) funds research and development programs to support its regulatory and operational activities. Table 25 shows that in 1985 the total DOT budget request for R&D is $491 million in current dollars ($429 million in 1982 dollars), which represents a slight increase in nominal funding but a 4 percent real decrease from 1984. The 1985 nominal request is 32 percent above the 1980 level, representing a real decrease of 2 percent. Development programs account for 83 percent of all DOT R&D funding, the same as in 1984 and up from 78 percent in 1980. Only a tiny fraction of DOT R&D is devoted to basic research, all in Maritime Administration programs.

With the exceptions of DoD and NSF, every other major federal sponsor of R&D experienced a greater reduction in real R&D funding from

TABLE 25. DOT R&D FUNDING BY CATEGORY (By fiscal year, in millions of dollars of budget authority and in percents)

Category	1980 a/	1984 b/	1985 c/	1989 d/
		Current Dollars		
Basic	0	1	0	e/
Applied	82	80	83	e/
Development	291	407	407	e/
Total	373	488	491	400
		1982 Dollars		
Basic	0	1	0	e/
Applied	96	74	72	e/
Development	342	374	355	e/
Total	438	448	429	291
		Percentage Share		
Basic	--	0.1	0.1	e/
Applied	22.0	16.4	16.9	e/
Development	78.0	83.4	82.9	e/

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget and the Department of Transportation budget submission to the Congress.

a. Actual.
b. Estimated.
c. Requested.
d. Projected from Administration budget submissions.
e. Not available.

1980 to 1985 than has DOT. The reason for this lies in the Federal Aviation Administration's (FAA) major commitment to modernizing air traffic control systems, a program that makes up a major share of the entire DOT R&D budget. The R&D programs of the other DOT agencies exhibit budget reductions similar to those in most other civilian agencies. In particular, the R&D budgets of the Urban Mass Transportation Administration, the Federal Railroad Administration, and the Maritime Administration have been cut significantly.

Federal Aviation Administration

The rationale for the preferred treatment accorded the FAA modernization program has two aspects. First, the FAA's R&D program involves technologies for which the government is the principal or sole purchaser. Since no private party purchases the specialized equipment used in air traffic control, the government must assume responsibility for its development--much as the government funds the R&D costs involved in providing defense goods. Second, these costs are financed by users of air traffic control systems through user taxes paid into the Airport and Airway Trust Fund. The Highway Trust Fund plays a similar role for Federal Highway Administration R&D.

The FAA accounts for 57 percent of total DOT R&D funding. FAA R&D programs have been increasing in recent years in anticipation of the expansion and modernization of the air traffic control system. The last major modernization took place more than ten years ago, so that the computers and other equipment used by the FAA are substantially out of date. (The FAA is reputed to be the largest consumer of vacuum tubes in the United States.) The FAA plans to spend $7.6 billion (in 1982 dollars) through the year 2000 to increase its capacity and productivity in order to meet targeted post-1990 air traffic demands and to improve the safety and efficiency of air travel. 14/ To do this, the FAA is emphasizing further development of advanced computer technologies, improvements in air traffic control, and programs in aviation weather and aircraft safety. As in 1984, advanced computer funding--at $153 million--continues to account for the bulk of FAA R&D funding in 1985. This program was a major source of the 1984 increase over 1983.

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14. See Congressional Budget Office, Improving the Air Traffic Control System: An Assessment of the National Airspace System Plan (August 1983).

From 1983 to 1984, total FAA R&D funding increased from $127 million ($122 million) to $272 million ($250 million). Because of cuts in other DOT R&D programs, the FAA increase exceeds the increase in the overall DOT R&D budget. FAA R&D funding has levelled off in the 1985 request; at $277 million ($242 million), the 1985 request represents a slight decrease in real terms from the 1984 level. Of this figure, 93 percent represents development. Funding for FAA R&D programs can be expected to remain level and then decrease as the modernization of the air traffic control system proceeds.

National Highway Traffic Safety Administration

The National Highway Traffic Safety Administration (NHTSA) is the second largest source of R&D funding in DOT. NHTSA conducts research related to highway, traffic, and motor-vehicle safety as well as programs aimed at increasing consumer awareness of motor-vehicle safety and maintenance. Although NHTSA's 1985 R&D request of $63 million represents an increase of 18 (12) percent over 1984, its R&D funding is still 27 percent less than the 1980 level in real terms. Development accounts for roughly 56 percent of NHTSA's 1985 R&D funding, the rest going to applied research. The 1985 budget request provides increased funding for programs aimed at boosting safety-belt usage and combatting drunk driving. NHTSA also plans to continue research in the areas of vehicle design and manufacture related to accident involvement and injury reduction. Finally, NHTSA's National Center for Statistics and Analysis funds R&D involving accident and injury data.

Other DOT Agencies

DOT's 1985 budget request includes $60 million ($52 million) for R&D funded by the Federal Highway Administration (FHWA). This is 15 (8) percent above the 1984 level but 15 percent below the 1980 level in real terms. Of FHWA's R&D funding, 85 percent is devoted to development. Most of this work involves highway planning, design, construction, and maintenance. The FHWA is currently emphasizing highway safety and is also devoting more R&D resources to technology transfer, aimed at making state and local authorities aware of applicable technology developments that may reduce the loss of life, injuries, and property damage occurring in highway accidents.

The Urban Mass Transportation Administration (UMTA) has requested $38 million ($34 million) for R&D programs in 1985--a decrease of 22

(27) percent from 1984 and 45 (59) percent from 1980. Reduced R&D at UMTA largely reflects cuts in programs related to advanced forms of mass transit such as monorails and "people movers" (automated, short-haul systems such as those found at some airports). The R&D programs concentrate on applied research (21 percent of the total) and on the development and demonstration of new mass transit facilities, equipment, and techniques.

DOT's 1985 budget request includes $24 million ($21 million) for R&D funding by the Coast Guard, an increase of 4 (0) percent from 1984 and 9 (-19) percent from 1980. Increases are proposed for programs in search and rescue, aids to navigation, marine safety, enforcement of laws and treaties, and ice operations. These increases have been offset by proposed reductions in environmental protection and military-readiness programs.

The Federal Railroad Administration's budget request of $16 million ($14 million) remained level with fiscal year 1984--representing a slight real decrease. The 1985 funding request for Federal Railroad Administration (FRA) R&D is 63 (72) percent below the 1980 level. The reduction since 1980 is primarily due to the transfer of the FRA's test-track facility in Colorado in 1980 to the Association of American Railroads. The Federal Railroad Administration concentrates its R&D effort on safety programs related to equipment, operations, and the transport of hazardous materials.

The percentage reduction in R&D funding by the Maritime Administration has been greater than for any other DOT agency. In 1985, the Maritime Administration's R&D budget request is $4 million ($3.5 million), down from $13 million ($12 million) in 1984, representing a 69 (71) percent decrease. Compared with 1980, R&D funding by the Maritime Administration has fallen 76 (82) percent. The Maritime Administration's R&D programs have traditionally sought to boost the productivity and competitiveness of the U.S. shipbuilding and ship-operating industries. The Administration views such goals as private responsibilities and is thus seeking to replace Maritime Administration R&D by encouraging joint industry/government project formulation and contributions from industry. In addition, the Administration has cut funding for applied research projects.

Major Policy Issues

DOT R&D and the Private Sector. Despite budget cuts, DOT still funds a significant amount of R&D that might well be left to the private sector. The R&D programs of the Federal Railway Administration and the Maritime Administration are examples of industry-oriented R&D that repre-

sent a subsidy not enjoyed by most American industries. The Congress could consider allowing greater collaboration between these industries and the government in order to effect a transfer of these programs to the private sector. On the other hand, federal support for R&D related to the maritime industry could be justified on national defense grounds, while railroad programs could be justified on the grounds that the public sector owns a significant portion of the nation's rail transportation system.

Highway R&D. The Surface Transportation Assistance Act of 1982 increased highway taxes and highway spending by more than 50 percent. Despite the physical problems with the nation's highway infrastructure, however, relatively little is spent on either basic or applied research into highway materials or on alternative methods of maintenance and repair. 15/ Increased highway R&D could monitor the long-term effects of traffic on highway wear and tear under a wide variety of local conditions, updating federally funded studies carried out in the early 1960s by the American Association of State Highway Officials. In addition, highway R&D could more clearly define the characteristics of asphaltic binders in order to produce longer lasting pavements, and develop alternatives to the use of salt to control ice and snow in order to increase the life of bridges and similar structures. A drawback to increased R&D spending is that existing programs for road construction and repair probably would have to be reduced.

DEPARTMENT OF COMMERCE

One of the many functions included in the mission of the Department of Commerce is support for R&D, especially through two agencies: the National Oceanic and Atmospheric Administration (NOAA) and the National Bureau of Standards (NBS). The R&D activities of these two agencies account for slightly over 95 percent of R&D funding by the Department of Commerce. Both NOAA and NBS traditionally carry out a substantial amount of practically oriented civilian applied research, a funding category that receives little support from the Administration elsewhere in the budget. As a result, these agencies and the overall Commerce R&D budget have been under severe budgetary pressure in recent years.

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15. See Congressional Budget Office, Public Works Infrastructure: Policy Considerations for the 1980s (April 1983).

The overall pattern of Commerce R&D funding is described in Table 26. The budget request for 1985 is 25 percent below the 1984 level in nominal terms (29 percent in real terms) and 24 (44) percent below the 1980 level. It should be pointed out, however, that the estimated 1984 funding of $358 million ($329 million in 1982 dollars), shown in Table 26, was increased by the Congress above the 1984 budget request of $240 million ($221 million), largely because of Congressional support for R&D at NOAA and NBS. Hence, the 1985 request continues the Administration's policy of cutting the Commerce R&D budget.

One noteworthy feature demonstrated by the data presented in Table 26 is that Commerce R&D funding does not exhibit the shift toward basic research that characterizes the R&D funding of other civilian agencies. Applied research has increased its share of Commerce R&D funding since 1980, while the share of basic research and development have each fallen about 25 percent. Of course, as noted above, both NOAA and NBS have traditionally emphasized applied research as part of their mission.

NOAA Funding Patterns

Table 27 provides analagous information concerning the pattern of R&D spending at NOAA. NOAA carries out a wide variety of activities that relate to the air and water environment. It provides resource-related R&D, cartographic services, environmental R&D, and promotional support to marine-based industries, such as fishing and ocean-bed mining. NOAA's marine programs also include Great Lakes projects. In addition, NOAA conducts meteorological surveys and research and provides satellite services, such as the LANDSAT program that was developed by NASA. LANDSAT is categorized as operations rather than R&D, and the Administration has in the past proposed transferring that program, as well as other NOAA satellite services, to the private sector. The 1985 budget takes no position on the privatization issue, however.

The requested NOAA R&D budget is $165 million, 19 percent of the total NOAA budget. This represents a decrease of 32 (36) percent from the level of 1984 funding approved by the Congress, although the 1985 request exceeds the 1984 request by 12 (7) percent. Basic research funding by NOAA has been eliminated since 1984.

NOAA R&D programs are being cut in all areas except some satellite support activities. Cuts are particularly evident in ocean, coastal, and marine fishery programs. Funding for ocean and coastal programs has been reduced to $32 million from $70 million in 1984. This reduction is achieved

TABLE 26. DEPARTMENT OF COMMERCE R&D FUNDING BY CATEGORY (By fiscal year, in millions of dollars of budget authority and in percents)

Category	1980 a/	1984 b/	1985 c/	1989 d/
		Current Dollars		
Basic	31	20	18	e/
Applied	235	270	200	e/
Development	88	68	51	e/
Total	354	358	269	286
		1982 Dollars		
Basic	36	18	16	e/
Applied	276	248	175	e/
Development	103	62	45	e/
Total	416	329	235	208
		Percentage Share		
Basic	8.8	5.6	6.7	e/
Applied	66.4	75.4	74.4	e/
Development	24.9	19.0	19.0	e/

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget and the Department of Commerce budget submission to the Congress.

a. Actual.
b. Estimated.
c. Requested.
d. Projected from Administration budget submissions.
e. Not available.

TABLE 27. NOAA R&D FUNDING BY CATEGORY (By fiscal year, in millions of dollars of budget authority and in percents)

Category	1980 a/	1984 b/	1985 c/	1989 d/
		Current Dollars		
Basic	16	0	0	e/
Applied	167	195	127	e/
Development	33	50	38	e/
Total	215	244	165	181
		1982 Dollars		
Basic	18	0	0	e/
Applied	196	179	111	e/
Development	39	46	33	e/
Total	253	224	144	132
		Percentage Share		
Basic	7.2	0.0	0.0	e/
Applied	77.4	79.6	77.0	e/
Development	15.4	20.4	23.0	e/

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget and the budget office of the National Oceanic and Atmospheric Administration.

a. Actual.
b. Estimated.
c. Requested.
d. Projected from Administration budget submissions.
e. Not available.

through the complete elimination of undersea research, ocean mineral evaluation projects, the Sea Grant program (which provided matching grants to universities and firms for marine-resource research), and most Great Lakes projects. Marine fishery resource programs, which provide information collection and analysis relating to fisheries, protected species, and coastal ecology, have been cut by $20 million, leaving $26 million for these projects. These cuts include roughly $9 million in reduced state grants, which are now funded at $1.2 million. The Administration has sought similar reductions in previous budget requests.

Funding for NOAA's atmospheric R&D programs has been reduced only slightly (from $78.8 million in 1984 to $74.1 million in 1985) in the 1985 budget request. Most of this reduction is for atmospheric and hydrological research, in which funding for weather modification has been eliminated, saving about $0.6 million.

NBS Funding Patterns

R&D funding at the National Bureau of Standards, described in Table 28, is reduced less than NOAA R&D funding, although the 1985 request calls for a 4 percent nominal reduction from the 1984 level (9 percent real). The principal mission of the NBS is to provide services to the private sector concerning measurement and standardization. The establishment of industry wide standards--for instance, in screw sizes or in computer languages--is crucial to industrial progress. The government is not essential to this process, but it can play a facilitating role. In the numerically controlled machine tool area, for instance, both the NBS and the Air Force are fostering the development of standardized interfacing systems that allow equipment from different manufacturers to be integrated into large-scale machining complexes.

Most NBS activities represent applied research, and the Administration has characteristically questioned the propriety of government support for this activity. Funding for NBS programs in computer sciences and technology has been cut in half, to $5 million. As in the past, the Administration has proposed the elimination of funding for R&D in building technologies and for fire research. All these reductions are justified with the argument that the private sector can adequately support these activities.

The NBS R&D budget includes increased funding for measurement research and standards. Two new projects are planned in this area: the development of a cold neutron research facility for materials research and

TABLE 28. NBS R&D FUNDING BY CATEGORY (By fiscal year, in millions of dollars of budget authority and in percents)

Category	1980 a/	1984 b/	1985 c/	1989 d/
		Current Dollars		
Basic	13	19	18	e/
Applied	45	63	64	e/
Development	17	13	10	e/
Total	75	95	91	91
		1982 Dollars		
Basic	15	18	16	e/
Applied	53	58	56	e/
Development	20	12	9	e/
Total	88	87	80	66
		Percentage Share		
Basic	17.2	20.1	19.5	e/
Applied	60.5	65.9	69.9	e/
Development	22.3	14.0	10.7	e/

SOURCE: Congressional Budget Office from data provided by the Office of Management and Budget and the Department of Commerce budget submission to the Congress.

a. Actual.
b. Estimated.
c. Requested.
d. Projected from Administration budget submissions.
e. Not available.

research into industrial applications of biotechnology. These two programs have a combined proposed funding level of $3.5 million in 1985, or 4 percent of the NBS budget.

Major Policy Issues

Support for Applied Research. The R&D funded by the Commerce Department, particularly at NOAA and NBS, represents the kind of applied research that diffuses basic scientific advances throughout industry. This is particularly true for NBS, which is the only government agency whose principal mission is to provide broad-based technical support for industry. Administration efforts to decrease funding for applied civilian research may reduce the economic competitiveness of U.S. industry, particularly in emerging technologies, such as biotechnology or robotics. On the other hand, proponents of a more limited government role argue that NBS activities should be limited to the agency's measurement functions. Such observers question the ability of the government to determine which technologies should be brought closer to commercial use. Involving the government in this selection process, they argue, deemphasizes the role of entrepeneurs and firms that are more familiar with market signals. The issue of the role of applied research is relevant to Department of Commerce programs in fisheries, minerals, robotics, computers, biotechnology, and other industries.

APPENDIX

APPENDIX. AGENCY COMPONENTS OF BUDGET FUNCTIONS

This appendix describes the agency R&D programs that make up the budget functions discussed in Chapter II.

Defense (050)	- Department of Defense-Military - Department of Energy defense programs - Federal Emergency Management Agency
Space (250)	- National Aeronautics and Space Administration (except aeronautical research and technology)
General Science (250)	- National Science Foundation - Department of Energy General Science programs
Health (550)	- Health and Human Services (except human services programs) - Occupational Safety and Health Administration, Department of Labor
Energy (270)	- Department of Energy (except atomic energy defense activities and general science programs) - Nuclear Regulatory Commission - Environmental Protection Agency multi-media energy programs
Agriculture (350)	- Department of Agriculture (except Forest Service)
Natural Resources and the Environment (300)	- Department of the Interior - Environmental Protection Agency (except multi-media energy programs) - Forest Service, Department of Agriculture - Corps of Engineers, Department of Defense - National Oceanic and Atmospheric Administration, Department of Commerce
Transportation (400)	- Department of Transportation (all) - National Aeronautics and Space Administration, aeronautical research and technology